



REPORT
ON
MINOR IRRIGATION WORKS
(Maharashtra State)

COMMITTEE ON PLAN PROJECTS,
(Irrigation Team)
NEW DELHI
(October 1963)

Letter of Transmittal

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COMMITTEE ON PLAN PROJECTS
PLANNING COMMISSION
NEW DELHI

October 29, 1963.

MY DEAR NANDA JI,

The Minor Irrigation Team of Committee on Plan Projects completed studies of minor irrigation works in the State of Maharashtra sometime ago, and a draft report was duly sent to the State authorities. Finalisation of the report remained pending for a long time for want of comments, from that end. Eventually, however, a mutual discussion at Bombay on 9th October, 1963 enabled us to issue this report, which is sent herewith for your perusal.

Among major States of India, percentage of irrigated area to the total area under plough, is the lowest in Maharashtra. The State authorities are, therefore, fairly alive to the problems of irrigation. Yet, field studies conducted on numerous minor irrigation works in different parts of the State go to indicate that their irrigation potential, is not utilised to a satisfactory extent. For example in Nagpur Irrigation Circle utilisation percentage of irrigation potential on minor irrigation reservoirs works out to only about 34.6 percent. Again, actual utilisation of irrigation potential over 146 Bandharas in various divisions of the State, averaged to 38.4 percent only.

The Team has also pointed out that building of Bandharas for irrigation in heavy rainfall coastal areas, is not a technically sound proposition. Streams there have generally no water left after the rainy season, while during rains their serviceability is negligible.

In Vidarbha region large quantities of water held by reservoirs built at considerable costs, just evaporate away into atmosphere because winter cropping is not practised in the area. This is a matter of serious concern. The Team has, therefore, made a number of suggestions enjoined in this report, indicating how agricultural production from these works could be optimised.

The Team has also indicated the need for modification in the existing rules so as to permit light lift irrigation in the head reaches of minor irrigation schemes, which otherwise have to transmit water over long distances to cater for flow areas only, thus involving heavy water losses in seepage and evaporation. The Team feels that dispersal of irrigation benefits over larger areas at the cost of precious water, does not seem to be a wholesome policy.

(ii)

In contour bunding and soil conservation measures Maharashtra State is leading other States of India, yet in the matter of levelling of fields, which is a pre-requisite for practising irrigated agriculture, there is not sufficient consciousness among the cultivators. The terrain being generally undulating and soil depths being limited, the need for levelling up and terracing of fields seems urgent.

Under Agricultural aspects one of the Team's recommendations is to advance the sowing season of cotton in irrigated tracts from June-July to April-May leading to greater production per acre. The Team has also suggested replacement of *Jowar* crop commonly grown in Maharashtra with other suitable crops, which do not denude the fertility of soils, as *Jowar* does.

Our thanks are due to the State authorities in Maharashtra for extending to us the fullest co-operation in conducting field studies on various types of minor irrigation works in the State, thus enabling us to present this report.



Yours sincerely,

M. THIRUMALA RAO

Shri Gulzarilal Nanda,
Minister for Home Affairs,
Government of India,
NEW DELHI.

PREFACE

Minor Irrigation Team appointed by the Committee on Plan Projects undertook the study of minor irrigation works in Maharashtra State as part of the programme laid down in the Terms of Reference communicated *vide* Committee on Plan Projects Memorandum No. COPP/(4)/17/58, dated the 4th August, 1958 appearing on page 62 of this Report. The Team comprised Dr. A. N. Khosla, Leader, Shri Lal Singh, Retd. Director of Agriculture, Punjab, Shri Baleshwar Nath, Chief Engineer (Addl.) Members and Shri Mahavir Prasad, Irrigation Adviser, Ministry of Food and Agriculture, Member-*Ex-officio*.

Dr. A. N. Khosla relinquished Leadership of the Team on December 12, 1960 and Shri M. Thirumala Rao, M.P. took his place.

Shri Lal Singh ceased to be Member of the Team with effect from July 28, 1960 and Dr. Arjan Singh, Retd. Director of Agriculture, Punjab, was appointed Member in his place.

After a preliminary discussion on May 28, 1960 at Bombay, proceedings of which appear in *Appendix VIII*, field studies in Maharashtra State were started after the rainy season. In the first tour the Team visited the south-western part of the State and saw minor irrigation works in operation in the districts of Satara, Sangli, Poona, Kolaba and Ahmednagar. Later, the Team visited a number of works in the coastal areas, and in the districts of East and West Khandesh, Nasik and Vidarbha region where the Ex-Malguzari tanks built 200 to 300 years ago exist in large numbers.

The study primarily aimed at getting a techno-economic appraisal of the works completed during Plan periods. During this period considerable emphasis had been laid on creating new irrigation resources in the State but there has not been that degree of mobilisation of effort for utilisation thereof. The Team has, therefore, stressed upon this aspect of development of irrigation, with a view to help optimisation of agricultural production both from old and new works.

While looking into the question of planning and prospecting of further works it appeared that the State needs must have a unified code governing Irrigation works, apart from a comprehensive survey of its potentialities.

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CHAPTER I

General

1.1. The State of Maharashtra forms part of Western India. It comprises the Konkan and Deccan Plateau including Marathwada and Vidarbha area. Situated on the western coast and bordering the Arabian Sea, the State extends from latitude 16.4^{N} to 22.1^{N} and longitude 72.6 to 80.9^{E} .

1.2. The State can be divided physically into two unequal parts, i.e. coastal strip of Konkan and Deccan Plateau. The dividing range, commonly called 'Sahyadri', runs almost parallel to the Arabian Sea coast at a distance varying from 15 miles to 25 miles from one end of Maharashtra to the other. The crest of this main range has an altitude from 2,000 to 4,500 feet above sea level. Western sea-ward face of this strip is broken in succession. Topography of Konkan is generally undulating giving rise at a number of places to severe soil erosion.

1.3. Deccan Plateau situated on the eastern side of the 'Sahyadri' range slopes gradually from west to east. It has an elevation of about 2,000 feet near the Ghats and 1,400 feet in the central part of Marathwada and Sholapur districts and 900 feet in the south-east of Vidarbha. From eastern flank of 'Sahyadri' range several spurs of varying lengths stretch out in eastern direction. These spurs have height of 1,000 to 1,500 feet above the surrounding territory and demarcate different river valleys.

1.4. A number of rivers traverse this territory. The main streams are Krishna, Wardha, Venganga, Bhima and Godavari. In fact, the whole of Maharashtra State is undulating Plateau with a number of river valleys. The most fertile valleys are, however, situated along rivers Godavari, Bhima and Krishna. The rest of the area is hilly with thin *moorum* and is marked with undulating topography.

1.5. Geologically, the basic complex of the whole State is of volcanic origin. There are a few coastal strips which have oceanic rock formations. In the eastern districts of Vidarbha out crops of granite are also seen. The districts of Nagpur and Chanda present a natural museum of different rock formations older than the trap such as granite, Dharward's laterites etc. The Deccan trap, however, occupies the largest area of the State. The rocks show varied colours and textures giving rise to variety of soils in varying proportions in different areas. There are alkaline soils which are met with all over the State and *khar* and *khajan* lands in the coastal areas. Apart from this all the other soils can broadly be classified into three categories (1) black soils (2) red soils and (3) laterite soils. The laterite soils are found in Ratnagiri and parts of Kolhapur districts. While the red soils cover the southern parts of Maharashtra and include narrow strips of coastal alluvium, the black soils predominate in the rest of the State. By and large all these soils have low level of fertility. Both red and black soils are generally deficient in nitrogen, phosphorous and organic matter which are the chief soil ingredients for raising good crops. The red soils are also deficient in lime but black soils contain adequate lime as also potash. The laterite soils are poor in lime contents and are acidic in reaction. Though the nitrogenous contents are fair yet phosphates and potash are rather low. A soil map of the state is shown in Figure 1.1.

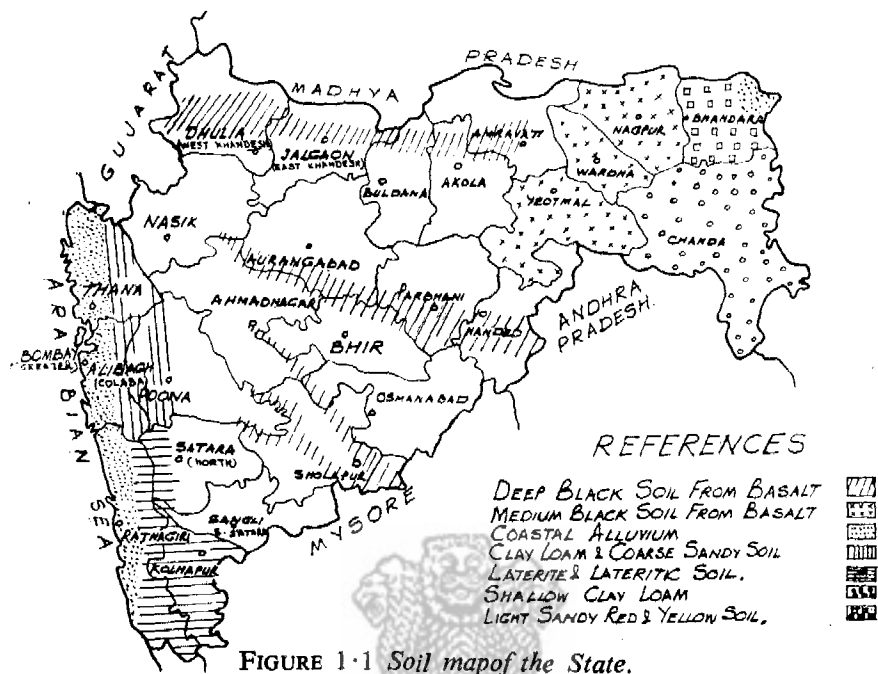


FIGURE 1.1 Soil map of the State.

1.6. The State of Maharashtra is the third largest State in the Indian Union both in respect of area and population. It has a total area of 1,18,884 sq. miles, which is about 10.54 per cent of the Indian Union as per provisional figures of census, 1961. The population of the State according to the 1961 census is 39,504,294 and is roughly 9.05 per cent of the total Indian population. The density of population is 332 as against 384 persons per sq. mile average of the Indian Union. While in Greater Bombay the density of population is 16,109 in Chanda district it is only 106. There is, therefore, a great disparity in the population distribution of the State.

1.7. Most of the agricultural operations of the State are dependent on rainfall. In fact, rainfall and soil determine the cropping pattern of different parts of the State. There are areas which are predominantly *kharif*, while there are others, which are both *kharif* and *rabi*. In low rainfall areas cultivators usually get one crop only. The choice of the people is naturally restricted to very few crops like *Bajri*, *moong*, etc. in the *kharif* and *jowar* etc. in the *rabi* season. This aspect has been discussed in details later in this Report.

1.8. From the point of view of rainfall, the State can be divided into four regions.

- (i) Coastal areas comprise Thana, Kolaba and Ratnagiri districts. In this area, the average rainfall is about 80 inches, but it exceeds even 200 inches at some places in the hilly areas of the Western Ghats.
- (ii) Plateau areas : In the eastern sides of the Ghats covering the areas of the districts of West Khandesh, Nashik, part of Poona, South Satara, Sholapur and Ahmednagar the rainfall

gradually declines from an average of 80 inches to 25 inches. In some parts of the above districts the rainfall scarcely exceeds 20". However, more or less semi-arid conditions prevail in this area.

- (iii) Marathwada area : Rainfall in this area is 30 to 40 inches.
- (iv) Vidarbha area : This is a high lying plateau of Poona Division. The rainfall in this area varies from 30 inches to 60 inches, being more on the eastern side and less on the western side.

The distribution of the rainfall is thus uneven over the State. In some areas there are partial or complete failures of rainfall leading to scarcity conditions. The average total rainfall for the State as a whole is about 42 inches of which nearly 82 per cent is received during monsoon months *i.e.* from June to September. In the post monsoon period, from October to November, only a few inches of rain are received. The winter months from December to March are practically dry, the total rainfall received in this period being less than two inches. Then again, in April and May, which are classified as pre-monsoon period, the precipitation increases but very slightly. It is altogether inadequate for early sowing. Thus, in view of long spell of practically dry weather during winter and summer months, over almost the entire State, fuller exploitation of water resources both of surface and underground is of vital importance to the State. An isohyetal map of the State is shown in Figure 1.2.

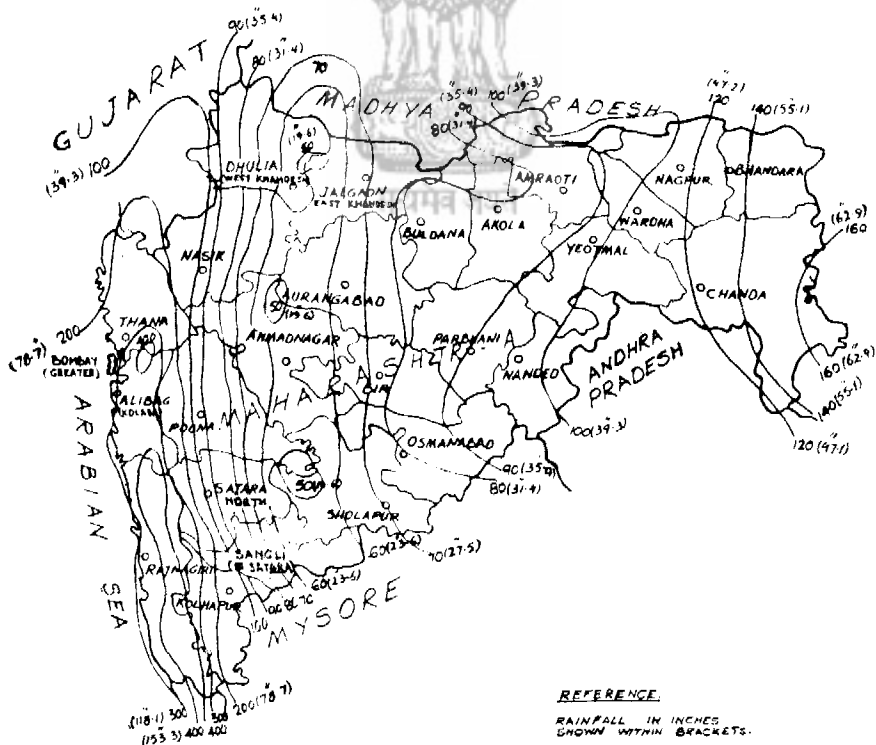


FIGURE 1.2

An isohyetal map of the State.

1.9. The possibility of having major irrigation works being very limited, the State, by and large, depends mostly on medium and minor irrigation works. These too have not so far been developed adequately. According to 1956-57 figures out of the total cultivated area of 4,42,94,600 acres in the State, only 22,62,200 acres get benefit of any irrigation. This works out to a percentage of 5.1 only. This percentage is the lowest among the States in the Indian Union.

1.10. A source-wise statement of irrigated figures based on 1956-57 statistics is shown in *Appendix I*. This will indicate that major part of irrigation is done by minor irrigation works. In fact wells alone account for 51.79 per cent of irrigation in the State. The scope for developing minor irrigation works in the State is great. For that reason, the State is having a Directorate specifically for Minor irrigation works under an officer of the rank of Chief Engineer with headquarter at Poona. This Directorate works in liaison with the Agriculture Department of the State.

1.11. Minor irrigation works in the State can be classified into different categories as given below :—

- (i) Storage reservoirs with canal systems laid out either on one or on both banks.
- (ii) Small diversion canals taking off from Bandharas.
- (iii) Minor Irrigation tanks including Nistar tanks.
- (iv) Nala-bunding and reclamation of Saline *Khar* lands.
- (v) Wells fed by percolation tanks.
- (vi) Ordinary open wells.
- (vii) Lift irrigation schemes from natural rivers.

1.12. These different types of irrigation works combined with other measures of agricultural development like soil conservation, land improvement, contour-bunding, afforestation, dry farming and double cropping, reclamation of saline soils have been studied by the Team with a view to suggest ways and means to improve their execution, performance and efficiency so that the production from the land and water resources of State could be maximised and the investment made on works could yield to the State and to the people better financial returns. The Team's observations are contained in the following Chapters.

CHAPTER II

Diversion Canals and Bandharas

2.1. Rainfall pattern of Maharashtra is such that very little water is left in the streams after rainy season. They remain mostly dry till the following monsoon. However, on the slopes of Sahyadri range in western Maharashtra region, some rivers carry discharges dwindling almost to nil in the month of March and April. From these streams some diversion canals had been built in the past and some were built only recently. Besides small weirs, still smaller units of diversion weirs called *Bandharas*, are possible in many localities in western Maharashtra and part of Marathwada region. These *bandharas* had, in most cases, been built by the cultivators themselves as *Kacha/Pucca* works. Small channels were led off to supply water to small commands, wherever need therefor arose. In later years attempts have been made by the State Government to improve these *bandharas*, and to build channels in a more scientific manner.

2.2. An overall picture of these *bandharas* as included in First Five-Year Plan and the Second Five Year Plan is given below :

No. of Bandharas

		In first plan period	In second plan period
West Maharashtra	.. .. .	261	221
Vidarbha	.. .. .	Nil	18
Marathwada	.. .. .	7	16
		268	255

The Bandharas visited by the Team during their field study have been shown in figure 2.1.

RAJANALA LEFT BANK CANAL

2.3. There are certain regions in western Maharashtra, which have the advantage of perennial supplies, from the tail race of the hydro-electric schemes. Irrigation works on these can be planned with more dependable supplies. The Team during their visit had occasion to inspect one such scheme "Rajanala", near Karjat in Kolaba district. This scheme consists of building a diversion canal from perennial supply available in the Rajanala, through tail discharges of Bhivpuri Hydro-electric Station of Tatas. The discharge at the tail is of the order of about 325 cusecs. Though rainfall in this area is about 125 inches in a year, yet the terrain is such that moisture is not retained in the soil and no water is left during hot season. The scheme envisages providing irrigation to about 4,000 acres of paddy land. It is also intended to irrigate a second crop, after harvesting the monsoon crop.

2.4. The canal takes off from Rajanala at R.L. 301.00 near village Karalwadi. The diversion work consists of a masonry weir 108 feet long

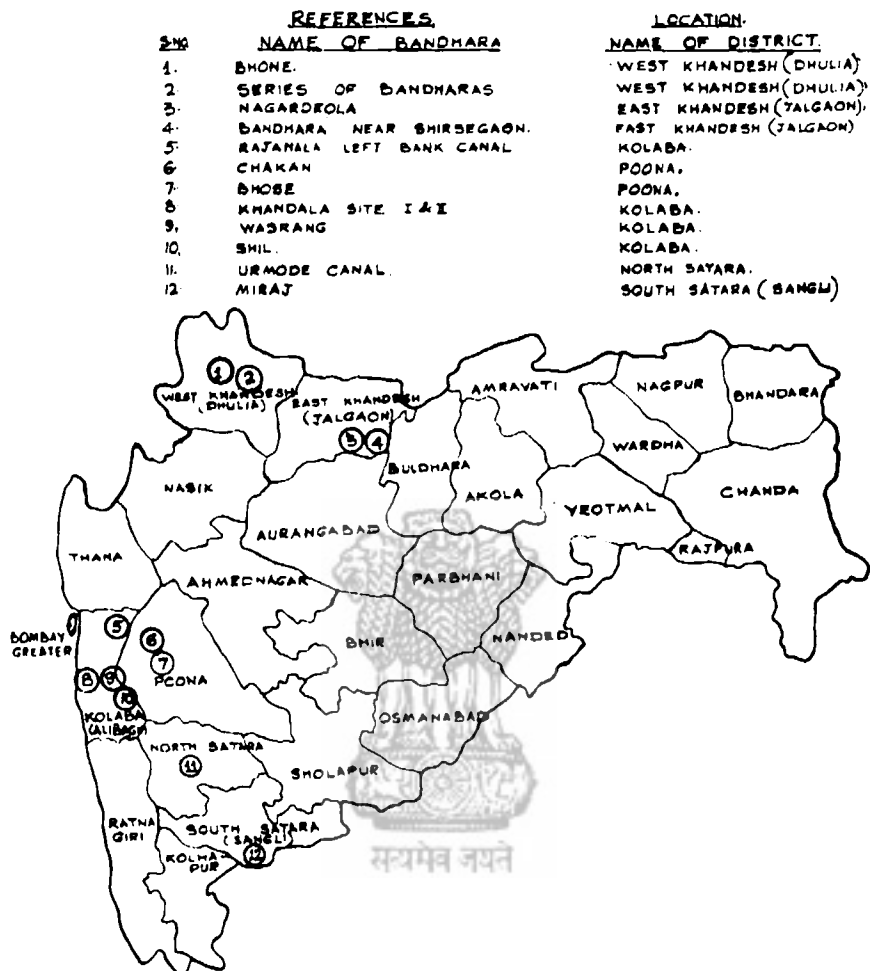


FIGURE 2.1 Showing location of Bandharas

and 6.5 feet high above bed level. The canal head has three openings of 6'x4' and is provided with M.S. gates. The carrying capacity of the canal is 200 cusecs. The system consists of 19 distributaries with a total length of 28 miles. Besides, 27 outlets are provided from the main canal to irrigate small pockets of 15 to 20 acres each.

2.5. The channel at the time of the Team's visit was under construction. Though the soil is poor yet the compaction work was being done without any sheep-foot roller. It is felt that a more detailed examination of soil profiles and more scientific treatment of compacted embankments should be pressed upon on such works. It will also be advantageous if the actual work is preceded with *Namunas* or profiles of the channel sections built at say $\frac{1}{2}$ furlong intervals. When these *Namunas* are passed, then the actual work should be permitted in between profiles. They will afford good alignment and enforce control of the quality of work.

2.6. Field channels.—It was observed by the Team that the construction of field channels is the responsibility of the cultivators. In fact, the system has not been provided with any properly laid out field channels. Field channels used in one year are demolished after they have served the purpose and are re-built in the following season. Their condition naturally is not satisfactory. Lot of percolation takes place. Water is wasted. It would seem better, if a properly laid out system of field channels is adopted, particularly on canals where perennial supply is available.

This work was originally started in 1953-54 as a Community Development project in Thana-Kolaba Community Development Block. The construction had lingered on for a period of almost eight years and the progress as reported is given in Table 2.1.

TABLE 2.1.

Year *	Works carried out on	
	Main Canal	Distributaries
1	2	3
1953-54	25% Earth work completed	
1954-55	Bandhara at Rajanala and Poj completed 20% Earth work completed 15 C.D. Works in progress and completed	
1955-56	10% Earth work completed 8 C.D. works completed	
1956-57	8 C.D. works completed	.. Earth work and C.D. works on Distributary No. 1 to 5 in progress.
1957-58	25% Earth work completed 15 C.D. works in progress and completed	.. Earth work of Distributary No. 1 to 5 completed.
1958-59	10% Earth work completed 12 C.D. works completed	.. Earth work of Distributary No. 6, 9, 10 & 12 started. .. C.D. works on Distributary No. 1 to 5 completed.
1959-60	10% Earth work completed 14 C.D. works in progress Brick-lining 100 Rft. completed	.. Earth work of Distributary 9, 10, 11, 13-A, 13-B, 15 and 18 in progress. .. Head works of Distributary No. 11, 12, 13-A, 13-B, 14 and 15 in progress.

TABLE 2.1 (contd.)

1	2	3
1960-61	17 C.D. works completed	Head work of Distributary No. 11, 12, 13-A, 13-B, 14 and 15 completed.
	17 C.D. works in progress	Earth work of Distributary No. 9, 10, 11, 13-A and 14 completed.
		Earth work of Distributary No. 13-A, 15 and 18 in progress. Distributary No. 8 and 8-A started.

This in its turn led to increased cost, partly owing to change in the project provisions by way of increase in the number of cross-drainage works and also due to rise in the cost of labour. The original project of Rs. 13,15,000 has thus gone up to Rs. 21,38,155. If the work had been planned to be executed in shorter period and greater speed had been attained in the pace of construction, the cost would not have gone so high and also the benefits of irrigation would have been available to the cultivators earlier.

2.7. Discussing the prospects of agricultural improvements with the introduction of the canal system with perennial supply, the Team had met a progressive farmer of the area. This farmer thought that he could grow only late crop of rice, as normally early paddy crop was attacked by pest leading to lower yield. He was, therefore, inclined to have only *rabi* crops and forego *kharif* crops. This is a serious matter, which should be considered by the Agriculture Department. In fact, with a Research Centre existing in close proximity of this canal, it should be possible for the Agriculture Department to encourage growing both *kharif* and *rabi* crops in this area, so as to develop a balanced crop pattern on this canal system.

2.8. Another peculiar feature of this terrain is poor levelling of the fields with the result that the water cannot be applied uniformly. There is accumulation of water at one end and there is shortage at the other. It would be advantageous, if State help in the shape of loan or subsidy is rendered to the cultivators to enable them to level up their fields. Levelling of fields should be an essential pre-requisite of irrigation, particularly on a perennial canal system. Any investment made in this direction will pay considerable dividends by way of increased production.

URMODI CANAL

2.9. Another diversion canal visited by the Team was across river Urmodi near village Walse. This work was first sanctioned at a cost of Rs. 11,34,500 in 1952, and included provision of 15 miles canal length, cost of cross drainage works and land acquisition. That was on a rough basis. Later on, administrative approval was accorded for Rs. 15,67,503

in 1956. Thereafter, in 1957 technical sanction was accorded to the project at a cost of Rs. 17,16,409. The work started early in 1954 and was nearing completion at the time of Team's visit in Nov./December 1960. The main features of the scheme are reproduced below :—

Catchment area	84 Sq. miles
Maximum overall discharge	62,753 cusecs
Masonry weir	435 ft. long
Weir Section	6'—6" top width 1 in 6 upstream 1 in 3 down stream 14 ft.
Maximum height	15 miles
Main canal length	107 cusecs
Discharge at head	10 ft. bed width 1:1 side slopes 1 in 5,000 bed slope
Section of the Canal	43 Nos.
Distributaries	4,646 acres
Gross commanded area	4,101 acres
Irrigable area	
Intendetod be irrigated :	
Rice	3,029 acres
Dry kharif	1,072 acres
	4,101 acres

A special feature of this project is that the post-monsoon flow of Urmodi river is available only for a limited period. It reduces to about 10 cusecs in December and falls sharply thereafter.

It was gathered that during *kharif* 1960, applications had been received for 160 acres only. Demand for *kharif* is dependant on rainfall. As a revenue earner, therefore, the performance of the system is not predictable. The capital cost per acre is worked out to Rs. 418, which is quite high for a project of such questionable overall utility.

2.10. With regard to the design of the channel system the Team had occasion to see that the outlets could be located to take off from the higher points so as to enable greater areas to be commanded through flow irrigation. As an illustration, the first two outlets on right and left of distributary No. 36 could be fixed with greater advantage in the main canal itself, thus commanding the areas, which have otherwise been left out.

2.11. As a policy, the Team is, however, unable to appreciate as to why should the channels be taken to longer lengths to command only flow areas. It seems advisable to change this policy and to stick to a more rational principle of providing irrigation, wherever it is feasible either by flow or by light lift in the upper reaches of the canal. This will *ipso facto*, obviate longer canal reaches and minimise percolation and evaporation losses accordingly. The lower areas on sloping ground will, to an extent, get automatically benefited through sub-surface flows and need not be

catered for at the cost of higher areas in the upper reaches, if it is possible to irrigate them with minor lifts.

2.12. Against the annual irrigable area of 4,101 acres, actual irrigation on Urmodi canal has been as given below :—

1957-58 (Canal functioned only up to Mile 9)	<i>Kharif</i>	170·20
	<i>Rabi</i>	8·10
	TOTAL	178·30
1958-59	<i>Kharif</i>	Nil
	<i>Rabi</i>	551·30
	TOTAL	551·30
1959-60	<i>Kharif</i>	22·00
	<i>Rabi</i>	267·00
	TOTAL	289·00
1960-61	<i>Kharif</i>	152·00
	<i>Rabi</i>	198·00
	TOTAL	350·00

This performance falls short of the targets, though the scheme has been in operation for about three years now. On revenue side the maximum assessment so far has been Rs. 2,997 in 1960-61 against the maintenance cost of Rs. 4,493. On a minor irrigation scheme of this magnitude it is expected that the development should be faster so that benefits accrue at greater pace to the irrigators as well as to the State.

2.13. A number of outlets and distributaries are only acting as escape channels as no water distribution field channels have yet been built. If the field channels are completed early, irrigation will develop at a faster pace. The entire agricultural pattern is based on rice cultivation, which is stipulated to be irrigated to the extent of 3,029 acres per year. Rice irrigation does not take place, if the rainfall is good. In fact, during the years gone by, there has been more *rabi* irrigation on this channel than rice itself. It would seem advisable, if greater emphasis is laid on developing *rabi* crops and evolving suitable crop pattern so that production from this canal system is maximised. So far it is gathered that out of a total of 43, no irrigation has taken place on 10 outlets and distributaries and on quite a number of other outlets irrigation is negligible. The outlet-wise performance is shown in *Appendix II*.

2.14. The Team also observed that on Urmodi canal, direct lift was permitted from the canal in the case of Survey No. 61 of Village Nandgaon. For this purpose a 5 H.P. engine was installed by the irrigator. He lifted water directly from the canal. This system does not seem to be conducive to the development of a healthy irrigation practice. It would seem more desirable, if outlets for lift irrigation are given at required sites and water lifted from the sumps constructed for the purpose outside the canal boundary, according to the convenience of the cultivator. The supplies thus withdrawn from the canal will not disturb the regime of the canal and affect irrigation in the lower reaches.

KHANDALA I & II BANDHARAS

2.15. The Team had occasion to inspect a number of *bandharas*. Two *bandharas* near Alibagh known as Khandala I and Khandala II were built in 1952 and 1953 at a cost of Rs. 3,602 and Rs. 6,186, and command an area of 200 and 400 acres respectively. Irrigation figures on them are given in Table 2.2.

TABLE 2.2

Name of the work 1	Area commanded 2	Year 3	Area irrigated 4
Khandala I	200	1952—53	160
		1953—54	160
		1954—55	160
		1955—56	160
		1956—57	—
		1957—58	—
		1958—59	191
Khandala II	400	1953—54	30
		1954—55	60
		1955—56	30
		1956—57	30
		1957—58	11
		1958—59	110

Water rates are not levied on such draught *bandharas*. Round figures shown above are indicative of the fact that no proper booking of irrigation was done, and the figures reported are on tentative basis. Even so, it is not understood why in one case, irrigation has been attained to an extent of about 80%, and in the other, 10 to 20%. The reaches in which these *bandharas* are situated are hardly four furlongs apart. The weather and climatic conditions must have been identical. The disparity in the irrigation performance, therefore, is not understandable. What appears, however, is that these *bandharas* might have rendered this much service even in the *kacha pucca* state previously run by the cultivators themselves. State investment on them does not seem to have yielded any benefit to the State, and benefit to the cultivators themselves also looks problematic.

2.16. Looking at the performance of these *bandharas*, it is for consideration, if such works which are called *kharif bandharas*, should at all be built. If there is rainfall during *kharif* season, they are not utilised. In rabi season, there is no water in the streams on which they are located and they cannot be of any use. Any investment on *kharif bandharas*, therefore, does not lead to any yield in Governmental revenues and even any increase in agricultural production.

WASRANG AND SHIL BANDHARAS

2.17. The Team had also occasion to visit two *bandharas* at Wasrang and Shil located on Patalganga stream. Since this stream gets supply from tail waters of Tata's Hydro Electric Scheme at Khopoli, they have more or less a perennial supply. It was on the recommendation of the Tail Water Utilisation Committee appointed by the Government of Bombay in 1946 that Wasrang *Bandhara* Scheme was taken up to help grow more food and cultivate second crop of paddy or vegetables in the fair season from the tail water released from the Hydro Electric Works. The discharge from the Power House is fluctuating and can go up to 600 cusecs.

2.18. The *Bandhara* at Wasrang is located near village Wasrang. It is a masonry wall with top width 2'—6" and batter 1 : 3 on the downstream face. The upstream face is vertical. The length of the *Bandhara* is 270 ft. and has two flank walls. The crest level is at R.L. 208.00, with one scouring sluice 3'×5'. The work was administratively approved at a cost of Rs. 99,717. The completion cost is Rs. 87,640.

2.19. The banks of the stream had to be protected upstream of this *Bandhara* to the length of 165 ft. on the left and 1,100 ft. on the right. This has been done with embankment built of soil and *murum*. The top of the embankment has been kept at R.L. 210.00 along a free board of two feet.

2.20. The canal taking off on the right, runs to a length of 16,400 feet. Its bed width is three feet in the head reaches and the bed slope is three feet per mile. The carrying capacity is seven cusecs and commands an area of about 350 acres in Khalapur Taluka.

2.21. One great functional difficulty with this canal is that it incurs heavy seepage losses and the adjoining fields have sometimes 2 to 3 inches water-depth due to it. Lining of the canal is, therefore, urgently called for in such reaches. Application of bentonite may help sealing the surface to an extent. This could be tried. Brick lining has been provided in small reaches.

2.22. The irrigation done by this *bandhara* in years 1957-58, 58-59, 59-60 and 60-61 is 50, 96, 162 and 210 acres respectively. The irrigation is coming up though gradually. Faster pace of development is, however, called for. All this irrigation has taken place during *rabi* and hot weather. Water-rate @ Rs. 4 per acre is charged besides irrigation cess of Rs. 7.5 per acre. The total revenues earned during the years 1957-58, 1958-59, 1959-60 and 1960-61 are Rs. 584, Rs. 1,107, Rs. 1,879 and Rs. 2,265 respectively. The maintenance cost per year works out to Rs. 4,000 to Rs. 5,000 on this system. There is thus a loss of about Rs. 2,000 per year, without taking into account the interest and overhead departmental charges.

2.23. It is felt that a *bandhara* with a perennial supply like Wasrang could positively be made self-paying, if proper crop pattern is adopted and economies are effected in the maintenance of the system.

SHIL BANDHARA

2.24. This is another *bandhara* named Shil in the downstream of the same (Patalganga) river, located at mile 63.8 of Poona-Bombay road. It is a masonry structure with top width of five feet. The upstream face is vertical and the downstream batter 1 : 3. Its maximum height is five feet and minimum three feet. The length of the *bandhara* is 136 feet and it has two scouring sluices of 3'×3'.

2.25. The canal taking off from right bank is 15,600 feet in length. It is designed for 7 cusecs discharge and has a command of 150 acres in hot weather. The actual figures of irrigation on it from 1954-55 to 1960-61 are given below :—

	Acres
1954-55	77
1955-56	77
1956-57	95
1957-58	84
1958-59	97
1959-60	128
1960-61	150

Water rate for paddy crop is Rs. 4 per acre per season and Rs. 5 per acre for vegetable. Rice is the main crop during the *rabi* season and there is no irrigation during *kharif*.

2.26. This *bandhara* is under the control of the Revenue Department, while Wasrang is looked after by the P.W.D. A co-ordinated control of the two schemes will undoubtedly be more efficient and may also lead to better water management and ultimately better production.

NAGARDEOLA BANDHARA

2.27. Nagardeola *bandhara* on river Titur is situated near Nagardeola Railway Station in Taluka Pachora, district Jalgaon. It has catchment area of 330 sq. miles with 35 inches annual rainfall. Construction was started in February 1953 as scarcity work financed from the Government of India—Loan programme. It was completed in 1955. The *bandhara* is 6 feet top width with an average height of 10 feet above bed level 540 feet in length. The main canal about 7 miles in length is designed for 62.50 cusecs discharge, having a command of 3,000 acres.

2.28. The financial forecast of the project.

	Rs.
Total cost of the project	6,01,000
Revenue: <i>Kharif</i> 1,400 acres @Rs. 6 per acre	8,400
<i>Rabi</i> 1,600 acres @Rs. 8 per acre	12,800
	21,200

	Rs.
Deduct working expenses @ $\frac{1}{2}$ % of the cost	3,000
M. & R. expenditure	3,000
Loss of assessment	300
	6,300
Net revenue expected	21,200
	6,300
	14,900

Performance of the *bandhara* is given in Table 2.3.

TABLE 2.3

Year	<i>Kharif</i>		<i>Rabi</i>		Total	
	Irriga- tion (acres)	Assess- ment (Rs.)	Irriga- tion (acres)	Assess- ment (Rs.)	Irriga- tion (acres)	Assess- ment (Rs.)
1953-54	—	—	160	1,680	160	1,680
1954-55	—	—	243	2,552	243	2,552
1955-56	—	—	229	2,850	229	2,850
1956-57	—	—	503	4,513	503	4,513
1957-58	109	1,302	406	4,700	515	6,002
1958-59	51	441	319	3,982	370	4,423
1959-60	63	380	442	4,700	505	5,080
1960-61	63	380	233	2,446	296	2,826
Total from 1957-58 to 1960-61 ..	286	2,503	1,400	15,828	1,686	18,331
Average per year	71	628	350	3,957	421	4,583

Kharif irrigation actually commenced on this *bandhara* from the year 1957-58. Leaving aside the previous years from 1953-54 as development period, average irrigation per year from 1957-58 to 1960-61 comes to 421 acres and assessment Rs. 4,581 against the annual target of 3,000 acres irrigation and Rs. 21,200 assessment respectively.

2.29. The scheme could not prove to be productive, both for the cultivators and the Government in eight years time. Insufficient flow of water in the river is stated to be the reason for low irrigation on the *bandhara* in *rabi* and *kharif*. This aspect should actually have been taken into account during the investigation of the scheme and if the position of supplies in the river on the hydrological observations of the previous

years was not dependable, as it has proved now, the scheme could have been curtailed to a lower level of investment. The project costing over six *lakhs* and capable of providing annual irrigation to 3,000 acres, has hardly given protection to 421 acres, which is 14% of the targeted figures, as indicated by the average for the last four years.

2.30. Estimated cost of the project per acre (6,01,000/3,000) is Rs. 200 whereas the effective cost (6,01,000/421) comes to Rs. 1,428. This will go to reflect that either the scheme has been designed without assuring adequate supplies of water at its source or on a wishful presumption that areas which are not easily commandable, will get benefited. Both these presumptions lead to unattainable targeting and disappointing field performance.

BHONE BANDHARA

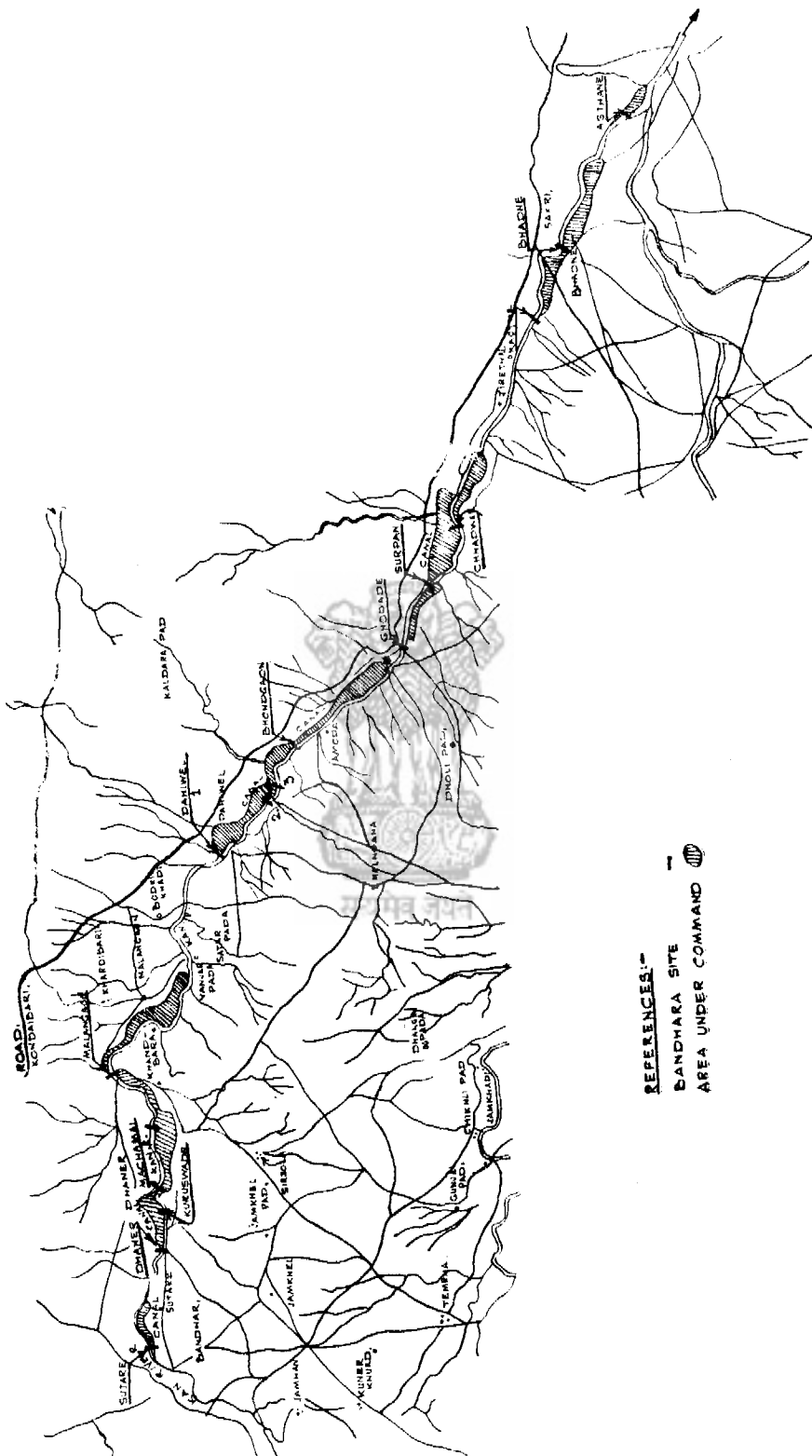
2.31. The Bhone *bandhara* is constructed across river Patalganga near village Nandurbar, district Dhulia. The work on this project was completed in the year 1952. But, the channel has not so far been completed. A time-lag of nine years between the completion of *bandhara* weir and the channel is a matter of concern. The project was first sanctioned for Rs. 34,588. The channel built to an extent of about 5,700 feet could not carry water, because the slope given to canal in cutting $\frac{1}{2} : 1$ was unstable. As a result, a special repairs estimate was sanctioned for Rs. 12,145 to provide lined side walls on certain reaches and to improve side slopes of canal $1\frac{1}{2}$ to 1. Even so, there has been no irrigation whatsoever from this channel, because land acquisition proceedings and the distributaries could not be completed earlier than 1959 and March 1961 respectively. The time-lag has, therefore, resulted in the lock-up of capital spent on the construction of *bandhara* and the consequential irrigation benefits to the areas intended to be served by this canal system.

SERIES OF BANDHARAS

2.32. A special feature of Maharashtra is the possibility that the terram affords for construction of series of *bandharas* on some of the rivers. One of such series was visited by the Team on Kan river. There are 14 *bandharas* on this river, as are indicated in plan (Figure 2.2). This river joins Panzara river, which again has got series of *bandharas*. This system leads to fuller utilisation of water because the escaped water from one *bandhara* by way of over-flow, wastage or percolation is picked up by the next one downstream, and so on.

2.33. A great limitation on development of irrigation is imposed by the *Phad* system, which is followed in this area. In this system, the management of the *bandhara* rests with the beneficiaries, who as a matter of practice, do not let the water to be utilised in other adjoining areas even when it is available. It would seem worthwhile if this system is re-examined, so that the use of available water could be extended over the larger areas as far as possible.

2.34. A statement showing the areas irrigated at present on the *bandharas* at Kan river, *taluka* Sakri, district Dhulia is given in Table 2.4.



Showing series Bandharas

FIGURE 2-2

TABLE 2.4

Name of bandhara	Area under command	Area Irrigable	Average area irrigated in 1954-55 & 55-56	Maximum area irrigated in one year
1	2	3	4	5
Sutare	21	21	21	21
Dhaner	61	61	61	61
Kurnswade	28	28	28	28
Machamal	74	74	53	74
Khandbara	82	82	63	82
Malangaon	5	5	--	5
Dahiwal				
I } II } III }	288	288	133	288
Bhondgaon	22	22	17	22
Ghodade	174	174	57	174
Surpan	49	49	57	49
Chhadwal	133	133	84	133
Jirethal		Data not given		
Kaothe	216	216	168	216
Bhadne	288	288	268	288
Asthane	57	57	41	57
	1,498	1,498	1,051	1,498

2.35. Apparently, the areas commanded are presumed as irrigated in large number of cases. No field-wise recording is actually done. It is felt that such schemes where a series of *bandharas* exist could with advantage be integrated and placed under P.W.D. control. Wherever there is possibility of re-modelling the schemes with a view to enlarging the scope of irrigation therefrom, it should be done. This requires closer examination of the different systems of *bandharas*, wherever possibilities of improvement exist.

BANDHARA ON RIVER DAMAN NEAR SHIRSEGAON

2.36. This is an old *bandhara* on river Damam near Shirsegaon, *taluka* Chalisgaon. This *bandhara* was strengthened in 1951 at a total cost of Rs. 63,115 to benefit about 500 acres of land in *kharif* and *rabi*. The irrigation thereon since its construction is given in the Table 2.5.

TABLE 2.5

Year	<i>kharif</i>		<i>rabi</i>	
	Area Irrigated A.G.	Assessment (Rs.)	Area Irrigated A.G.	Assessment (Rs.)
1	2	3	4	5
1950-51 to 1954-55	Nil	Nil	Nil	Nil
1955-56	Nil	Nil	163—35	2,277
1956-57	Nil	Nil	92—0	966
1957-58	Nil	Nil	16—32	293
1958-59	20—16	243	151—7	1,757
1959-60	Nil	Nil	Nil	Nil
1960-61	Nil	Nil	Nil	Nil

2.37. As the figures indicate, the *bandhara* has not proved of any assistance to the area during *kharif* in 8 years out of 9 years. In *rabi* too it has been of use only for 4 years. The performance is much below the expectations. It only, therefore, leads to the following conclusions :—

- (i) that the *bandhara* is useless in *kharif* and serves only casually during *rabi*.
- (ii) the investment of Rs. 63,115 on the *bandhara* has not yielded results commensurate with the money spent on its strengthening.

May be, sufficient agricultural activities have not been initiated in the tract for the utilisation of the available supplies. In any case, the area is almost scarcity tract. Rainfall is scanty. There is no question of any perennial supplies in the rivers. As such, creation of *bandharas* in such areas is very problematic. The Team feels that in such areas, instead of *bandharas*, contour bunding and *nalla* plugging should be adopted, so that sub-soil gets enriched with whatever precipitation takes place in the area. Where, however, suitable locations are available as on this *bandhara*, percolation tanks could also be put up, which would help enrich sub-soil supplies.

2.38. The views expressed by the authorities concerned for poor performance on this *bandhara* are as given below :

- (i) *Nalla* is nearly dry.
- (ii) Irrigation is made as per demand.
- (iii) Due to fluctuation in discharge of rivers, the area of *rabi* irrigation varies according to the sustained discharge.
- (iv) Where there is ample supply in *kharif* season, irrigators do not require water and when there is a little discharge in *nalla* during *rabi* season, irrigators demand for water and hence the figures of area actually irrigated are less than the potential area.
- (v) Levy of irrigation cess on canal water rates is felt as an additional burden by the irrigators.

Apparently, the scheme has been ill-conceived, inasmuch as the irrigation potential has been pitched to an unrealistic figures, particularly with such uncertain supplies in the river in different years.

BHOSE BANDHARA

2.39. Bhoose *bandhara* in *tuluka* Khed, district Poona, constructed in March, 1956 at a cost of Rs. 12,900 was visited by the Team.

Part of the right retaining wall of the canal close to the weir had collapsed and water was rejoining the stream. This collapse is reported to have occurred some two years back and thus since then there is no irrigation possible.

2.40. This work, meant to irrigate 175 acres, is with the Revenue Department. No effective steps appear to have been taken to restore the collapsed portion of the retaining wall of the canal.

CHAKAN BANDHARA

2.41. Another *bandhara* visited by the Team was Chakan in *taluka* Khed, district Poona. This work was completed in March, 1956 at a cost of Rs. 20,760 and had to give 140 acres annual irrigation. This work also, being of the order of below 250 acres, is with the Revenue Department.

2.42. There is no irrigation on this *bandhara* and the reason for the same, as reported, is that "the *bandhara* is defective, i.e., *bandhara* is below the level of the lands." Apparently, the area intended to be served is far off. A channel has to be cut across the high intervening land. This has not been done so far. As such, the *bandhara* has not served any purpose ever since it was built in 1956.

MIRAJ BANDHARA

2.43. *Bandhara* at Miraj, district Sangli, was also visited by the Team. Stated to have been constructed before the Plan Period at a cost of Rs. 14,003 the *bandhara* has a catchment area of 16.38 sq. miles. In a command of 350 acres, it was intended to irrigate 231 acres annually. Cost per acre was Rs. 61. It is provided with a left bank canal about 27 furlongs in length. Area intended to be irrigated being below 250 acres, its management and maintenance is also under the Revenue Department.

Due to heavy silting up of the left flank, the head of the canal is completely choked up. Unutilised water flows in the stream. This state of affairs continues. No irrigation is stated to have taken place on this scheme from 1947/48 (from whence irrigation figures were required to be intimated) onwards to date.

This scheme is located in an area with only 15 inches average annual rainfall and could have been a useful asset to the cultivators and to the State, if it was maintained and regulated in a proper manner. Probably P.W.D. supervision may prove more useful in such cases.

UTILISATION

2.44. The Team looked into the irrigation performance of a number of *bandharas* taken from different Divisions of the State. Of the *bandharas* completed in the First Five Year Plan, irrigation figures were available for 144 *bandharas* for the year 1959-60. These figures along with their cost of completion, area intended to be irrigated, and the area actually irrigated in the year 1959-60 are given in Table 2.6.

TABLE 2.6

Canal Irrigation Divisions	No. of works	Total cost of the works	Irrigation potentials (acres)	Actual Irrigation (acres)	% of Utilisation of irrigation potential	Cost per acre (CCA)	Cost per acre (effective)
1	2	3	4	5	6	7	8
Kolaba	2	2,65,409	900	293	32.6	294.9	905.5
Ratnagiri	2	33,377	380	250	65.8	87.8	133.5
South Satara	19	2,65,690	3,105	1,213	39.1	85.6	219.0
Sholapur	3	53,000	355	147	41.4	149.3	360.5
Kolhapur	18	1,53,732	2,636	762	28.9	59.3	201.7

1	2	3	4	5	6	7	8
West Khandesh ..	23	4,07,408	6,543	2,370	36.2	62.3	171.9
North Satara ..	29	1,73,220	3,128	1,994	63.7	55.4	86.9
Poona West ..	3	29,844	265	67	25.3	112.6	445.4
Poona East ..	2	39,720	315	Nil	Nil	126.1	Nil
Poona Irrigation ..	35	2,17,639	3,503	1,544	46.7	65.9	140.9
Nasik Irrigation ..	1	9,270	80	130	162.5	115.9	71.3
Vidarbha-Region ..	2	63,481	1,410	289	19.9	43.8	219.6
East Khandesh ..	5	1,26,474	1,542	161	10.4	83.0	785.5
Maharashtra State ..	146	18,38,264	24,002	9,220	38.4	76.6	199.4

From the above, it will appear that the irrigational performance of these *bandharas* has not come up to the mark though more than three years have elapsed since their completion. This is the maximum developmental period that could be taken into account in such small minor irrigation schemes. As it is, against the capital cost of construction of 18,38,264/24,002=Rs. 76.0 the effective capital cost of construction works out to Rs. 18,38,264 divided by 9,220=Rs. 199.4. Also the utilisation percentage is 38.4 of the potential fixed for irrigation. In a tract like Maharashtra where the rainfall is scanty and water shortage is often felt, a higher utilisation is expected from such minor irrigation schemes. Apparently there is great lacuna in the planning and operation of the schemes. The Team feels :

(1) that *bandharas* which have been designed for *kharif* actually do not serve any purpose during *kharif* and have no water during *rabi*. As such planning of *kharif bandharas* itself is questionable. The State Government should re-orientate their planning techniques in this respect;

(2) even where the *bandharas* have been built, the water channels have not properly been aligned and constructed so as to lead to an optimum utilisation of the supplies available for irrigation purposes. This eventually leads to low irrigation performance;

(3) levelling of fields is by and large very poor in the commands of these *bandharas* and water, as applied to crops, is used uneconomically and even unscientifically. It would be advantageous if the Agriculture Department or the Extension Services, if instituted in Block areas, take special interest in arranging for more economic use of water;

(4) quite a number of *bandharas* serve paddy areas which are high water-consuming crops. If proper crop pattern with a view to more economic utilisation of water is evolved, irrigational performance of the *bandharas* is bound to improve;

(5) though not possible in all cases, yet in a few cases, the supplies in the *bandharas* could be established if storages are built in the upper reaches of their catchment either through terracing or through contour bunding and the period of supplies be extended thereby. If the supplies continue in these *bandharas* a little longer, they will prove useful for the *rabi* crops and their utility would thereby increase. A system of terracing in the upper reaches may prove feasible in certain cases. This will enable holding up of water during the rainy season, releasing it after the rains, and making use of the emergent land for agricultural purposes while relieving water to be utilised through the *bandharas* in the lower areas.

CHAPTER III

Storage Reservoirs and Irrigation Tanks

3.1. Maharashtra State, particularly the eastern region, abounds in tanks. Rainfall in this part of the country is comparatively scanty, particularly in Ahmednagar and Sholapur areas. Since soil depths are not favourable, a system of tanks exists throughout the region. Practically in all villages and towns Nistar tanks exist. They serve irrigation purposes to some extent. While a few new tanks are being built, and a few reconditioned, a large number of old tanks, particularly in Chanda and Bhandara districts, are deteriorating.

3.2. The Team during their field studies had occasion to see a large number of irrigation and Nistar-cum-irrigation tanks (Figure 3.1) main features of which are contained in the following paragraphs along with observations of the Team.

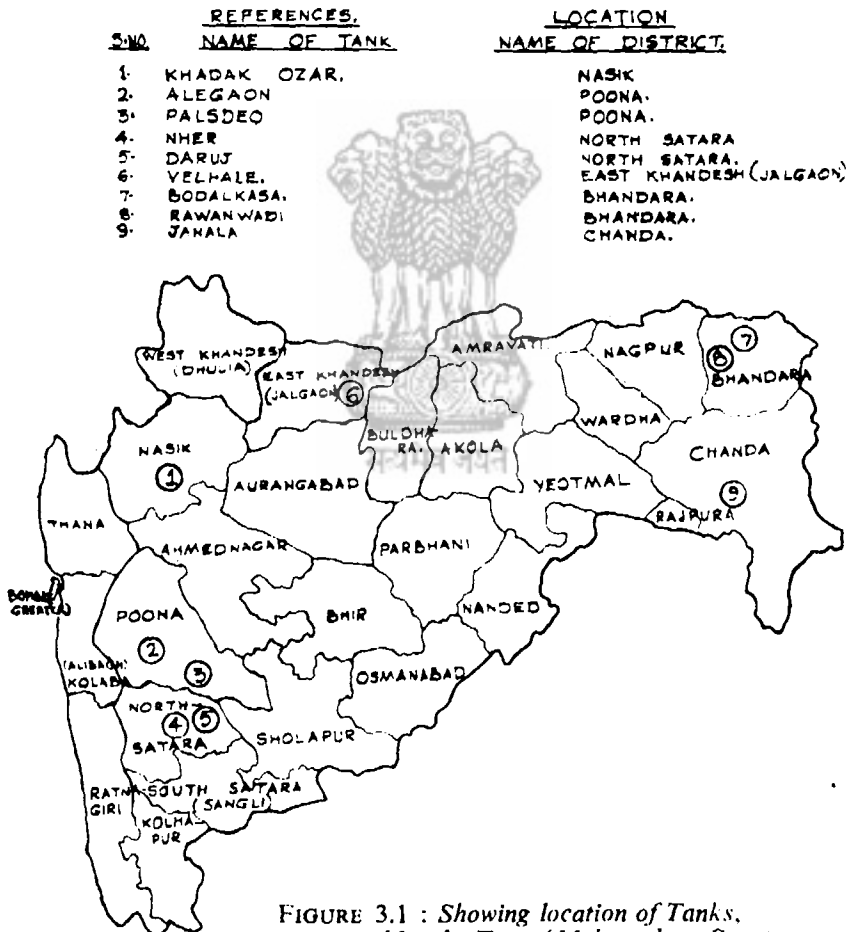


FIGURE 3.1 : Showing location of Tanks,
as visited by the Team (Maharashtra State)

ALEGAON TANK

3.3. Alegaon tank is situated in *taluka* Sinnar of Poona district. It is under construction, with an estimated cost of Rs. 10 lakhs. It has a catchment area of 13.57 sq. miles, located in the zone of 19 inches average annual rainfall. The earthen dam is 950 feet long, 49.46 feet high, with 12 feet top width, and the tank is designed for 72 Mcft. storage capacity at F.S.L. It was to be provided with two waste weirs, 360 feet long on left bank and 290 feet long on right bank. A left bank canal, seven miles in length designed for a maximum discharge of 19 cusecs, to irrigate 1,225 acres area is to be the only off-taking channel. Estimated cost of the scheme was Rs. 7,82,069; cost per Mcft. Rs. 12,772 and cost per acre irrigated Rs. 638.

3.4. The scheme is envisaged to bring annual gross receipts of Rs. 12,862 @ Rs. 8 per acre water rate and after deducting Rs. 5,511 working expenses @ $\frac{1}{2}\%$, would yield a net revenue of Rs. 7,351 to the exchequer. This economics may not hold good now as there is 30% increase in the probable cost of the work portions, which is Rs. 10,26,000 as per revised estimate. Cost per acre irrigated thus rises from Rs. 638 to Rs. 838.

The excess in the revised estimate is stated to be mainly due to :—

- (i) Excess on account of high tenders
- (ii) Extra item for excavation
- (iii) Extra keying on right bank and incorrect strata prediction.

The economic picture of the Scheme now finally emerging out, indicates that original project was based on the unrealistic planning.

3.5. The Team suggests that field test arrangements may be made at the Dam site for carrying out day to day soil tests.

3.6. Proper sized outlets may be fixed in the canal at suitable sites with demarcated commands and properly aligned water-courses.

3.7. To make the cultivators irrigation minded and change the time old dry farming practices to irrigated crop pattern, co-ordination of the Agriculture Department is required to effect the change. Suitable crop pattern needs to be evolved and propagated through Demonstration Farms. Creation of such pre-preparedness is bound to give a fillip to the proper utilisation of the conserved supplies in such precarious rainfall area.

3.8. The area, where this Alegaon tank is coming up, as also in Ahmednagar, is a scarcity area. The rainfall is poor. It was felt that if cloud seeding is done, some more rainfall may be possible. The Team, therefore, suggested that the experimental work may be started by Maharashtra State authorities on artificial rain making in this tract. Incidentally Poona is a good station from where seeding by air-craft could be done. The matter was later discussed by the Member of the Team with the Rain and Cloud Physics Unit of the Council of Industrial and Scientific Research. That Committee too, considered the area suitable for experimentation. The State authorities were accordingly advised—see *Appendix III*.

DARUJ TANK

3.9. Daruj tank on Karanja *Nalla* in Derajai village, Khatav *taluka*, is in scarcity area, where the rainfall is about 20 inches per year. Construction of the tank was taken up in February 1953, and involved building of a dam 2,850 feet long and 25 feet maximum height. Uptill March, 1956 the expenditure was Rs. 9,58,440, and at the end of March 1957, it stood at Rs. 11,71,625. The estimate for this project has not yet been closed and though some irrigation has started, the maintenance cost is being debited to the capital estimate.

3.10. The tank has catchment area of 16 square miles, and a capacity of 101.87 Mcft. The main canal taking off from the tank is 5 miles 1 chain in length and there are two distributaries, Wakeshwar and Statewadi, measuring 3 miles 27 chains and 1 mile 27 chains respectively. The gross commanded area of the system is 4,270 acres, of which 3,274 acres are irrigable.

3.11. Irrigational performance of the tank since 1955-56 is given in Table 3.1.

TABLE 3.1

Year	Gross command (acres)	Irrigable area (acres)	Actual yearly irrigation (acres)	Amount assessed (Rs.)
1	2	3	4	5
1955-56	4,270	3,274	204	1,743
1956-57	Do.	Do.	274	2,723
1957-58	Do.	Do.	300	3,067
1958-59	Do.	Do.	565	5,762
1959-60	Do.	Do.	576	6,032
1960-61	Do.	Do.	576	6,714

3.12. The performance at its maximum in 1960-61 is only 18 per cent of the targeted area, though a period of five years has elapsed since the system came into commission. There may be many contributory causes for this poor performance. The Team gathered that the channels have to be closed during night hours as the cultivators are averse to night watering. There should also be co-ordinated effort on the part of Irrigation, Agriculture and Public Relations Departments for proper utilisation of irrigation potential created in such a precarious area. The Team, therefore, feels that Experimental and Demonstration Farms need be established for educating the cultivators so that a change-over from dry to wet farming takes place in good time.

NHER TANK—YERALA RIVER WORKS

3.13. While in Satara, the Team had occasion to visit Yerala river works in Khatav *taluka*, which consist of Yerala right and left bank canal taking off from masonry weir at Khatgun. This is an old work completed sometime in the last century at a cost of roughly Rs. 7.5 lakhs. Against an irrigable area of about 5,400 acres, it has, on the average, done more than 5,000 acres annual irrigation. It is, therefore, a good revenue earner also.

It is, however, felt that the efficiency of the system, which has about 33 miles of channels, could be improved, if :—

- (i) the channel is provided with proper gauges at head, tail and control points, so that the quantity of water is regularly gauged, and a check-up on the use of water by different crops is adequately exercised;
- (ii) the outlets which are at present of earthen pipes may, with advantage, be replaced by fool-proof locking gate type outlets; and
- (iii) economies could be exercised in the maintenance, which at present requires a gang of about 30 labourers employed all the year round. Normally, as in Northern India, 3 to 5 miles length of channel is looked after on the average by one labourer. As such, about 10 labourers all the year round should suffice for the maintenance of these channels. Besides, it would seem more regular if this personnel is taken on monthly basis instead of muster-roll. However, it is a matter of detail, which the State authorities could better decide.

VELHALE TANK

3.14. This tank is located near village Velhale about 3 miles from the Verangaon Railway Station in *taluka* Bhusaval, district Jalgaon. The work was started in 1953 and completed in 1955 at a cost of Rs. 9,24,241. The tank has a catchment area of 10.54 sq. miles; capacity of 87.00 Mcft. with a dead storage of 13.69 Mcft. The channel system consists of 4 miles 6 furlong canal with distributaries of one mile each. The areas commanded and envisaged to be irrigated by this tank are shown below :—

	Acres
Gross area	2,244
Commanded area	1,828
Irrigable area	1,467

3.15. Irrigation started in 1955-56. Performance since that year up-to-date is given in the Table 3.2 :

TABLE 3.2

Year	Area irrigated			Maintenance & Repairs Expenditure	Assessment
	Kharif		Total		
	A	G	A G		
1	2	3	4	5	6
1955-56	0—00	88—0	88—00	703	1,100
1956-57	34—00	166—0	200—00	450	1,884
1957-58	1—39	174—0	175—39	1,780	1,928
1958-59	24—00	300—0	324—00	4,367	3,744
1959-60	101—00	338—0	439—00	4,500	4,155
1960-61	162—00	367—0	529—00	3,332	4,826
TOTAL	322—39	1,433—0	1,755—39	15,132	17,637
AVERAGE	53—33	239—0	292—33		
			(say 293 acres.)		

3.16. While the average performance is far below the targeted figures, the maximum area irrigated was in the year 1960-61, 162 acres in *kharif* and 367 acres in *rabi*, totalling to 529 acres. There is considerable room for development of irrigation on this tank. As at present, against its capital cost of Rs. 630 per acre, the effective capital cost works out to Rs. 1,747 per acre.

3.17. It was gathered that there are about 17 private wells working within irrigable area of the scheme. They irrigate roughly 364 acres of land thus leaving only 1,100 acres of irrigable area in the gross command of the scheme. The main difficulty pointed out to the Team appeared in the fact that people are more interested in irrigating cash crops and do not care to irrigate food crops. Because of this tendency the stored water in the tank goes to waste through evaporation and percolation during *kharif* period. This is for consideration if the policy with regard to crop pattern to be followed by the people should be changed with a view to help greater utilisation of irrigation supplies as far as possible.

JANALA TANK

3.18. Janala tank is situated about 23 miles from Chanda on Chanda Mul road. Construction of this Pre-Plan Period earthen dam was started in 1908 and completed in 1912 at a cost of Rs. 15,739. Its length at the top is 2,055 feet and is provided with 155 feet long clear overfall type waste weir. It is located in 45.14 inches average annual rainfall tract with 2.5 sq. miles of catchment area. It had a gross storage capacity of 71.4 Mcft. Live storage now is 65.9 Mcft. and 5.5 Mcft. is the quantity of silt in the reservoir. Length of the canal and distributaries is 4.53 and 1.44 miles respectively.

3.19. The project has 4,231 acres area in its command. Culturable commanded area is 2,414 acres, and annual irrigable area is 525 acres (*kharif* 500, *Sugarcane* 25 acres). Irrigation is given mainly to Paddy in *kharif* and wheat, pulses and garden crops in *rabi*. Crop-wise irrigation, amount assessed and annual maintenance and repairs expenditure incurred on the scheme is given in the Table 3.3 :

TABLE 3.3

Year	Gross area	C.C.A.	Annual irrigable area	Irrigation			Amount assessed (Rs.)	M&R expenditure (Rs.)
				<i>Kharif</i>	<i>Rabi</i>	Total		
1	2	3	4	5	6	7	8	9
1947-48	..	4,231	2,414	<i>Kharif</i> 500 <i>Sugar-</i> <i>cane</i> 25	343	32	375	N.A.
1948-49	..				341	42	383	N.A.
1949-50	..	Do.	Do.	Do.	355	27	382	N.A.
1950-51	..	Do.	Do.	Do.	358	149	507	N.A.
1951-52	..	Do.	Do.	Do.	431	68	499	N.A.
1952-53	..	Do.	Do.	Do.	444	63	507	N.A.
1953-54	..	Do.	Do.	Do.	362	48	410	N.A.
1954-55	..	Do.	Do.	Do.	376	51	427	N.A.

1	2	3	4	5	6
1955-56 ..	376	57	433	1,264	25
1956-57 ..	380	75	455	981	923
1957-58 ..	405	33	438	959	1,960
1958-59 ..	407	38	445	2,028	888
1959-60 ..	536	49	585	2,526	1,872
1960-61 ..	582	41	623	1,334	2,355
Total from 1955-56 to 1960-61.				9,092	8,023
Yearly average				1,515	1,337

3.20. The average annual revenue earned by the scheme from 1955-56 onwards (the period for which annual M & R figures have been made available) comes to Rs. 1,515 against the average M & R expenditure of Rs. 1,337 leaving a meagre margin on the positive side. If, however, overhead departmental and other expenditures including interest on capital cost is taken into account, even this scheme will prove to be unproductive. There is thus room for improvement. The scheme has not been provided with properly aligned water-courses and irrigation is mostly done from field to field, which is wasteful. The available water can be profitably spread on more area through water-courses and can yield better results in *rabi* when irrigation is required to be extended to fields not adjoining each other.

3.21. Leakages were observed running through rocky fissures. The leakages stop when water level in the tank falls to seven feet above the sill level. Provision of a blanket is under the consideration of the State Authorities. Although there is no immediate danger to the bund, the leakage needs to be attended to at the earliest to stop further wastage of water. Scour below the waste weir is heavy and alarming. Early measures to arrest its progress are called for.

PALSDEO TANK

3.22. It is situated on right side of the Poona Sholapur Road at mile No. 71/1 in taluka Indapur, distt. Poona. It was taken up for construction in the year 1947 and completed in 1953-54 at a cost of Rs. 8,65,176, to provide a gross storage of 95.25 Mcft. and live storage of 89.25 Mcft. It was proposed for irrigating 1,380 acres of land (1,000 acres on right bank canal and 380 acres on left bank canal). Both right bank and left bank channels carry 15.48 cusecs and 7.56 cusecs discharge respectively.

3.23. The area irrigated since 1953-54 to 1960-61 on this tank is given in Table 3.4 :

TABLE 3.4

Year	Area irrigated (A-G)
1953-54	211—30
1954-55	87—10
1955-56	537—10
1956-57	181—00
1957-58	489—30
1958-59	478—30
1959-60	385—00
1960-61	523—00

3.24. Estimated cost per acre is to the order of Rs. 625, but assessing from the irrigation figures given above, and taking average irrigation about 500 acres per year, effective cost per acre comes to Rs. 1,733. Besides, in September 1961 when the M.I. Team visited the tank, it was observed that there was about 1 to 1½ cusecs of seepage of water flowing on the down stream side of the *bund*. It was gathered at site that full supply level in the tank had, therefore, been brought down by about 4 to 5 feet to minimise the seepage.

3.25. As a result of lowering the F.S.L. top layers of storage have been lost which form a good proportion of the tank supply. This, in its turn, affects irrigating capability of the scheme. The Team, therefore, feels that the problem should be investigated, as early as possible, and dam be rendered capable of holding the supply to its designed F.S.L. In the scarcity area, where average rain-fall is only about 18 inches, water is a precious commodity and needs to be conserved even at a high cost.

KHADAK—OZAR TANK PROJECT

3.26. Khadak-Ozar tank is located 3 miles to the south of village Vadali Bhir on Bombay-Agra Road, on river Vadali. The project was originally started in 1902 as scarcity work. A sum of Rs. 60,000 was then spent for puddle trench excavation. It was restarted in 1953-54, at an estimated cost of Rs. 17,29,733. It is an earthen dam 4,200 feet in length, designed for gross storage of 233.56 Mcft.

3.27. The estimate has since been revised to a figure of Rs. 27,14,268. This excess is attributed mainly to earth work and irrigation channel. Top of the dam has been raised to RL 93.75 from 93.00 and width of the berm 15 feet instead of 12 feet. As for the channels, it is stated, that provision in the original estimate for 3 miles length of the main canal, 8 miles length of two distributaries, 14 cross-drainage works, regulator and land acquisition was made on lump sum basis. The revision has been made after completion of contour survey *etc.*

3.28. The scheme is envisaged to bring to the exchequer an annual net revenue of Rs. 18,579 out of the gross receipts of Rs. 31,400 with water rates @ Rs. 8 per acre. It irrigates 3,925 acres in a total command of 6,000 acres. Irrigation capacity has been fixed as 3 waterings of 3 to 4 inches depth for *rabi* irrigation.

3.29. As it appeared, no advance action seems to have been taken to utilise the potential, as soon as it is created. It is felt that utilisation could be accelerated, if activities of the Agriculture Department are pre-planned and initiated well in time.

3.30. As for check up on the quality of earthwork it may be mentioned, that occasional checks may be exercised in an independent Laboratory unconnected with construction personnel to safeguard against any lacuna. Such a laboratory is available at Nasik.

3.31. Even light lift areas have been excluded from the command of the channels. The Team studied this aspect in some detail. There are

FIGURE 3.2 : Showing the levels for lift irrigation for the main canal from Khadak-Ozhar Tank, Nasik Irrigation Division—Maharashtra State.

areas (Figure 3.2) where minor lift say about 5 feet is required as in the case of survey Nos. 102 and 103 (area 23 acres) of village Jopul. In such cases irrigation can be done by manual lift. In survey Nos. 141 and 145 of village Jopul (area 58 acres) about 10 feet lift is required. Similarly in survey Nos. 76 to 87 of village Jopul, 125, 126, 132, 133, 135 to 148 of village Bhoygaon and 16, 17, 18 of village Deogaon, area totalling to 332 acres, about 15 feet lift is involved. Cultivators may be interested even to install small pumping sets on co-operative basis to utilise assured *rabi* supplies. For such compact irrigable blocks, initiative could be taken by the State Government themselves to provide lift irrigation at suitable rates, as is being done in Northern India and on some major irrigation Projects in Maharashtra too.

BODALKASA TANK

3.32. Bodalkasa tank located in Bhandara district was completed in the year 1923 at a cost of Rs. 6.74 lakhs. Cost per acre on the C.C.A. was Rs. 27. It has a designed storage capacity of 788 Mcft., gross command of 24,312 acres and annual irrigable area of 10,000 acres.

3.33. Year-wise irrigation figures, amount assessed and M & R expenditure from 1951-52 onwards are given in Table 3.5 :

TABLE 3.5

Year	Annual irrigable area (acres)	Actual irrigation (acres)	Amount assessed (Rs.)	Annual M & R expenditure (Rs.)
1	2	3	4	5
1951-52	10,000	11,300	N.A.	N.A.
1952-53	Do.	11,300	N.A.	N.A.
1953-54	Do.	11,300	N.A.	N.A.
1954-55	Do.	11,400	N.A.	N.A.
1955-56	Do.	11,400	27,332	10,623
1956-57	Do.	11,400	27,538	10,157
1957-58	Do.	11,900	29,646	9,719
1958-59	Do.	13,000	42,710	23,958
1959-60	Do.	12,100	42,639	27,774
1960-61	Do.	12,800	N.A.	36,787

The project expected to give 10,000 acres annual irrigation, has actually irrigated more area and irrigation went up to 13,000 acres in the year 1958-59.

Main irrigated crop on this system is *kharif* paddy. As a *rabi* follow on crop, *likhari* and *urd* are broadcast in some area. The Team feels that :—

- If proper *rabi* crop pattern is introduced there is ample scope for increase in irrigation.
- At present field to field irrigation is in practice. Extension of irrigation can be achieved with the layout of properly aligned water courses. The available supplies can be spread on more area.
- In view of the actual performance of the scheme, need for revision of the annual irrigable figure is apparent.

RAWANDWADI TANK

3.34. Rawandwadi Project was administratively approved by the Ex-Madhya Pradesh Government in 1953 for Rs. 4,41,739 which was later revised to Rs. 8.90 lakhs. It consists of an earthen dam 3,013 feet long and 41.6 feet high and a subsidiary *bund* of 2,650 feet length and 14.5 feet height, in between two hillocks. Canal bank road of four miles length has been constructed to facilitate approach to the dam site by car.

Salient features of the scheme are given below :—

1. Catchment area	5 sq. miles	
2. Average annual rainfall	50.4 inches	
3. Gross storage	243.85 Mcft.	
4. Net storage : (Irrigable capacity)	238.47 Mcft.	
5. Water spread area	598.20 acres	
6. Irrigation potential	2,000 acres	<i>kharif</i> <i>rahi</i>
	600 acres	
TOTAL ..		2,600 acres
7. Length of the Canals :		
Main canal	8 miles	
Distributaries	8 miles	
Discharge at head of main canal	37 cusecs	

On its completion and full development, the scheme is envisaged to give an additional production of 520 tons of foodgrains.

3.35. The work was taken up for execution in January 1953 and was in progress at the time of Team's visit in the first week of January, 1961. The progress achieved is as below :

Headworks

Main bund,	} Completed.
Sub-bund,	
Waste-weir	
and sluice	

Canals

(i) Earth work	} Completed.
(ii) Main canal	
(iii) Minors	

Out of 7 minors earthwork of 5 minors has been completed. About 2 miles of earthwork is yet to be done.

(iv) *Masonry works*

Out of total 107 masonry works on main canal and minors 44 No. are so far completed.

3.36. Rainfall during the year 1960-61 was 50.43 inches and monsoon yield 585 Mcft. Water level in the reservoir stood at R.L. 885.25 on 31-12-1960. In the year under review (1960-61) 420.91 Mcft. water passed over the waste weir. 41.22 Mcft. water was applied for irrigation of 945 acres in *kharif* (1960).

3.37. Irrigation and assessment figures on this system from 1957-58 to 1960-61 are given in Table 3.6.

TABLE 3.6

Year	Annual irrigable area (acres)	Actual irrigation (acres)	Amount assessed (Rs.)
1	2	3	4
1957-58	2,600	369	2,957
1958-59	2,600	—	—
1959-60	2,600	233	992
1960-61	2,600	945	3,451

3.38. The Team gathered that no provision for lift irrigation was made on this project. It is felt that small lifts can be negotiated either manually or through small pumping sets, and channel lengths can thus be curtailed, minimising losses in transmission, percolation and evaporation. Intensity of cultivation could be improved in areas close to the reservoir, where the seepage effect also has some influence.

3.39. Within the command of the project there is an Agriculture Farm at Pehla. It was distressing to find that no regular rotation of crops was being followed on the Farm. Crops grown are paddy and *Jowar* in the summer season, and wheat, gram and *jowar* in winter. Vegetables are also grown in small area. Yield of wheat was stated to be 4 maunds per acre. It is highly uneconomic to get such poor return. It also leaves a bad impression on the mind of cultivators of the neighbourhood. It is highly desirable that only suitable varieties of wheat are grown. With adoption of proper crop pattern maximum utilisation of the Rawandwadi reservoir supplies could be achieved.

3.40. From the data made available by the State Authorities, it is observed that utilisation aspect of the tanks in the State does not also present a healthy picture and is almost in line with the diversion canals and *bandharas*. Looking at the performance of the Pre-Plan Period tanks in the jurisdiction of Nagpur Irrigation Circle, it is seen that actual irrigation thereon (average for the last 3 years) is 1,08,428 acres against the targeted figure of 3,13,327 acres, i.e., 34.6%. On the diversion canals and *bandharas* percentage of utilisation is 38.4.

3.41. In the case of tanks taken up for construction after 1947 in the First and Second Plan Periods in Nagpur Irrigation Circle, Nira Right Bank Canal Division, Phalton and Jalgaon Irrigation Division, information about which is in hand, it is seen that percentage of utilisation is 36.2 which is more or less the same as on Pre-Plan-Period tanks.

3.42. This poor utilisation of conserved water in the State is therefore a matter for serious consideration. For this purpose a committee on "Utilisation of Irrigation Potential in the Maharashtra State" was set up some time back.

3.43. In many cases, it was observed by the Team, that there were appreciable quantities of unutilised water in the tanks at the end of *kharif* season. In some cases water carried over to for *rabi* season too was not properly utilised. By removing the apathy of the cultivators through propaganda, persuasion and demonstration, suitable changes in crop pattern, leading to larger areas under *kharif* irrigation, and cultivation and irrigation of *rabi* crops could be appreciably developed.

3.44. Taking into account the initial and recurring costs involved in conserving water, which is so scarce in Maharashtra, no stone should be left unturned to achieve full utilisation of the irrigation supplies available.

3.45. For the future schemes, it would be worthwhile to ascertain as to how far the beneficiaries would be enthusiastic to utilise the supplies and how much benefit would lands in the command draw from artificial irrigation. This approach would obviate wild-goose-chase that sometime takes place where uncertain schemes have been laid out, resulting in non-utilisation of water and unproductive investment of money, material, manpower as well as yearly recurring expenditure on maintenance.

3.46. To close the channels during the night hours, as was observed by the Team on certain works, on the ground that the cultivators are averse to night watering, is also an aspect needing immediate attention. Climatic and other conditions in other States where irrigation is done day and night may be severer than in Maharashtra State. There appears, therefore, to be no reason why this attitude of the cultivators in Maharashtra be not changed. This is a wasteful process involving unnecessary losses in the channels by repeated closures and more evaporation and seepage losses in the reservoirs.

3.47. Field to field irrigation practiced mostly in the State is another factor of low utilisation. With the proper layout of field channels, the same quantity of water can be used more economically as is the practice on major canals in the State.

3.48. Higher utilisation would mean more produce for the cultivator and more revenue for the State. As the matters stand, the minor irrigation works in the State hardly equate the recurring maintenance expenditure incurred on them by the State. Adding to them the interest on the capital cost and other overhead charges, turn the work unproductive.

3.49. To make the cultivators irrigation minded introduction of split-rate system of water charges may be considered. The beneficiaries may be levied certain standing rate per acre on the culturable commanded area in the command to cover the maintenance and other expenditure incurred by the State, whether they take irrigation or not. Those who actually irrigate may be required to pay an additional water rate. This system may well act as an inducement to the cultivators to take water, also at a little additional cost, in preference to paying the standing charges only for which they get no tangible return.

CHAPTER IV

Ex-Malguzari Tanks

4.1. With the abolition of proprietary rights in 1951 by virtue of Act I of 1951 of the Ex-Madhya Pradesh Government, the vast number of Malguzari tanks in Vidarbha region, now in Maharashtra State, also came to vest in the State Government. These tanks, some constructed 200 to 300 years ago to serve as temporary storage for meeting water scarcity, are protective and supplementing works, rather than irrigation tanks in the strict sense, and are not to the design standard practised by the Irrigation Department.

4.2. Built originally for Nistar purpose, some of the tanks later came to be developed into irrigation tanks as an insurance against the freakish monsoons, protecting paddy crop from frequent failures and growing of other crops with confidence. These tanks are an asset in Chanda and Bhandra districts called "rice bowls" of Maharashtra State like Thana and Konkan districts.

4.3. The problem of carrying out repairs to these tanks had been engaging the attention of the Government. The issue was considered by the Irrigation Commission appointed by the Ex-M.P. Government in 1901-03. It was again taken up by the Central Provinces Irrigation Committee in 1927-29. The efforts made during the period 1901 to 1950 did not result in any substantial repairs to these large number of tanks.

4.4. After the abolition of Malguzari system Ex-M.P. Government decided that the responsibility of maintenance and management of the tanks irrigating less than 100 acres be transferred to Village *Panchayats*, and those irrigating 100 acres and above should be looked after by the State P.W.D. No effective action for its implementation, however, appears to have been taken.

4.5. The question of renovation of Ex-Malguzari tank was considered at length by the composite Bombay State Government, resulting in issue of orders in G.R.P. & S.D. No. IRG-1459-S, dated 11-12-1959, (*Appendix IV*), under which 50% grant-in-aid of the cost of repairs was to be borne by the Government and the remaining 50% by the Society, Gram *Panchayat* or the Local beneficiaries as the case may be, by contribution in cash or by undertaking the work at below the normal rates, provided the overall cost of repairs per tank did not exceed Rs 10,000. The position regarding legal rights of the Government and the irrigators were to remain *status-quo*.

4.6. On reference to the *Wajib-ul-Urz*, it transpires that the lands which belonged to the Malguzars are entitled to free use of water and water rates are chargeable on lands belonging to the tenants of Malguzars, which are included in the land revenue assessment. Water rates were assessed firstly on the basis of suitability of soil for crops, secondly crops and thirdly irrigation facilities. Water rates on lands irrigated from the overflow of the waste weir were lower than those irrigated from the upper sluices and highest rates were charged on lands irrigated from the lower sluices. Extra assessment of water rates could be made if crops other than those specified in the village record were irrigated

4.7. *Prima facie* it can be said (as opined by R.L.A., Bombay State) that the various rights for entitlement to free irrigation etc. need be extinguished by payment of compensation under suitable legislation. Before, however, such legislation is enacted, it would be worthwhile to take up revision of settlement, (which is over due in the district concerned) in the course of which the water rates, and land revenue could be suitably increased with respect to water facilities to each survey No. This will prove very useful for bringing in the legislation in future. As far the Legal obligation of the Government for carrying out necessary repairs to the ex-malguzari tanks, it is well nigh established that they are as much responsible as the ex-Malguzars

4.8. Apart from few singular repair jobs, no repairs have been carried out from the year 1901, either by ex-Malguzars up to 1951, or thereafter by the Government, it is essential that the important aspect of renovation is taken up and executed at the earliest. It may be worth mentioning that area irrigated by the Malguzari tanks in 1954, according to the Agricultural Abstract was as under :—

District	Area irrigated
Bhandara	2.47 lakh acres
Chanda	1.27 „
Nagpur	0.13 „

At present there are only 1.24 lakh acres in Bhandara, 1.08 lakh acres in Chanda and 0.08 lakh acres in Nagpur district which are irrigated by water from them. Thus as against a total of 3.87 lakh acres irrigated in 1954 through this source, the present acreage under irrigation from these tanks has dwindled down to 2.40 lakh acres. Quite a substantial area has gone out of irrigation on account of deterioration of condition of tanks, some of them having become defunct for want of major repairs.

4.9. To check further deterioration it is, therefore, imperative to take up renovation on a phased programme on emergency basis. The Director, Minor Irrigation Maharashtra has drawn up a criteria for repair of these tanks. This is outlined in *Appendix V*. The Team has studied this note and consider that a calculated risk as envisaged to be taken by the authorities as renovating the spill-ways and dam sections is unavoidable. The renovation of these tanks is, however, a pressing need and firm programme thereabout should be drawn up preferably within Third Plan period.

MUL TANK

4.10. Ex-Malguzari Mul Tank in *taluka* and district Chanda was visited by the Team, *en route* from Chanda to Nagpur. Situated close to village Mul, it serves both as *nistar* and irrigation tank. Length of the earthen *bund* is 3,800 feet and height 14 feet. Another 1,200 feet extension in the length of the *bund* is proposed. Catchment is 1.04 sq. miles and dependable annual rainfall 40 inches.

Gross capacity of the reservoir is 14.60 Mcft. of which 12.5 Mcft. is live capacity and 1.46 Mcft. is silt. It has an irrigable command of 270 acres and area under submergence is 61.79 acres.

4.11. Condition of the tank has deteriorated considerably. Renovation, it is understood would be taken up in the Third Plan Period at a cost of Rs. 1.17 lakhs. Average cost per irrigated acre would be Rs. 470. Pucca waste weir 224 feet in length with 4 feet clear overfall will be provided.

4.12. Regarding performance of this tank no information could be had except that it is capable of irrigating 270 acres area. Although under the present conditions, no water rates are chargeable on irrigation from ex-malguzari tanks, yet it is imperative that record of irrigation is maintained to gauge their capacities and capabilities.

4.13. Water at present is applied mostly to *khari*f paddy. There is practically no *rabi* follow on crop. '*Biri*' making is a more lucrative job with the people of Chanda district. Water left over in the tanks after *khari*f irrigation mostly goes waste in evaporation and seepage. Although labour is kept occupied in *Biri* industry, the most salient aspect of land and water utilisation in *rabi* needs also to be kept in view. Some sort of incentive by the State Government may yield hopeful results. About 65% area of Chanda district is under forest, and there is thus all the more reason to utilise culturable area to its maximum to meet the food and other agricultural requirements.

KINHI TANK

4.14. Kinhi ex-malguzari tank in Ghorajhari sub-division of Minor Irrigation Division, Chanda, on 84th mile of Nagpur-Chanda road was visited next. This tank was renovated in 1956 at a cost of Rs. 43,186. Cost per Mcft. of storage and per acre irrigated came to Rs. 1,755 and Rs. 103 respectively. Situated in a zone with 53.5 inches average annual rainfall and with catchment of 1.20 sq. miles, it has a gross storage of 30.6 Mcft. and 1.7 Mcft. being silt in it, the live storage is 28.9 Mcft. It has been provided with 77 feet clear overfall type waste weir.

There is no defined canal taking off from the tank. Irrigation is done partly by water courses and partly by field to field.

4.15. Renovations were carried out by the then Irrigation Survey Division, Nagpur and thereafter for maintenance the work was transferred to the Minor Irrigation Division, Chanda, in 1956. The *bund* was re-sectioned keeping top width as 6 feet. Repairs of the sluice were also carried out.

4.16. Irrigation potential of the tank has been fixed as 400 acres *khari*f and 95 acres *rabi*. Actual irrigation done in this project is as under :—

Year	Irrigation		Total
	<i>Khari</i> f	<i>Rabi</i>	
(1)	(2)	(3)	(4)
1956-57	282	—	282
1957-58	286	—	286
1958-59	286	—	286
1959-60	282	5	287
1960-61	282	21	303

Although *khari*f irrigation is almost steady, 21 acres *rabi* irrigation was done in 1960-61. With the construction of the proposed canal and layout of properly aligned water courses, more area can come under irrigation.

DAHEGAON TANK

4.17. Dahegaon tank, situated in village Dahegaon, *taluka* and District Nagpur, was visited by the Team. This is an ex-malguzari tank belonging to Bhonsalas of Nagpur and functions as nistar-*cum*-irrigation tank. Its renovation was taken up by the State Government in the year 1955-56 and completed in 1957-58, at a cost of Rs. 22,317.

4.18. The tank is located in the area with 45 inches average annual rainfall and has submergence of about 87 acres at F.T.L. Gross capacity of the reservoir is 24.53 Mcft. Live storage is 10.13 Mcft. and 11.85 Mcft. of water remains below the lowest sluice level unutilised. The length at top of the dam is 4,750 feet and is provided with an open channel flush type 16 feet waste weir. Length of the canal is 43,000 feet and is designed for 3.88 cusecs discharge. It has 1,600 acres gross area in the command and culturable commanded area out of it is 1,450 acres. Annual irrigable area is 283 acres.

4.19. Its irrigation performance prior to 1954-55 is not known. In *rabi* 1958-59, after renovations, 15 acres area was irrigated, and in *rabi* 1959-60, 31.20 acres. There was no irrigation in *kharif*.

4.20. The Team interviewed some of the cultivators present at the tank. They stated that the supply is not available in the tank after February till June. They appeared quite enthusiastic to utilise water, if it could be managed.

To utilise 12 Mcft. of dead storage below the L.S. level, it may be worthwhile to instal a mobile pumping set for experimentation and watch the reactions of the cultivators. If they are positive and irrigation results are assuring, permanent pumping arrangements could be made. As an alternative, raising the present F.T.L. (R.L. 86.00) could be done by—say 3 feet up to R.L. 89.00, to have an additional storage of about 13 Mcft. over the present live capacity.

4.21. As the matters stand, the utilisation results are rather disheartening. If the results improve with assured supply measures, there will be justification of the expenditure incurred on renovation. There are vast chances of extension of irrigation in the culturable commanded area of 1,450 acres, with properly laid out water courses and technically sited outlets. There are a number of “*Sharifa*” plants on the bund which are auctioned by the Government. There are ample possibilities of plantation of other fruit trees and vegetable cultivation in the area under command on commercial scale. Its location close to Nagpur can provide a good and convenient market for the produce. The present crop pattern of cotton and *Jowar* in *kharif* and wheat, gram and *Jowar* in *rabi* could be suitably changed with the improvement in water supply conditions.

DESILTING-CUM-RECLAMATION

4.22. Most of the ex-malguzari tanks in particular have lost their original capacities on account of silting. Silting is a natural process and its extent depends on the nature and slope of the catchments, intensity of rainfall and capacity of the tanks compared to the catchments. Due to systematic denudation in the catchment, silting of a tank is a gradual and continuous process. The coarse materials from the catchment flowing with the run-off get deposited at the fore-shore and the finer materials in the deep bed of the tanks.

4.23. To restore the tanks to their original capacity by raising the waste weir means more submergence of land, and makes the project unremunerative due to the rising cost of land. The alternative is to remove silt from the tank bed. Roughly, to secure an additional one Mcft. of capacity by desilting would cost as much as Rs. 20,000 to Rs. 25,000, thus making it prohibitively costly.

4.24. It is, however, possible to regain to some extent the lost capacity of the tank with a judicious combination of both these methods of raising the waste weir and desilting the bed. Such a solution is already tried under the 'Desilting-cum-Reclamation Scheme' initiated by the P.W.D. of Madras State on an experimental basis.* It will in its turn help to reduce losses due to evaporation, as the area of water spread will get reduced when the tanks get deepened. Also the areas on the fore-shore which otherwise remain under water will get exposed and may be used for fore-shore plantation, wherever possible.

4.25. While visiting malguzari tanks in Chanda district, the Team noticed that at Hindustan Collieries situated only a couple of miles from Chanda town, water was being pumped out to an extent of 60,000 gallons per hour (about equal to the capacity of 2 Nos. $1\frac{1}{2}$ cusec tubewells), constantly throughout the year. It was gathered that no use is made of this water. As could be judged from the strata plan available in the colliery office, this water is contained in Kampti series rocks, which lie to a considerable depth below ground and are separated from the underlying coal seams by a fire-clay strata. The quality of water seemed good and the quantity dependable.

4.26. On a suggestion that colliery people may themselves utilise the water to develop the land they had taken on lease from the State Government, it transpired that they had no interest in agricultural development, whatsoever. The Team, however, feels that with water so readily available on such a dependable perennial basis and in such quantity, State Government may cause action for its utilisation for agricultural production purposes, preferably around the site of its extraction or in nearby areas.

4.27. This is not an isolated instance. It was gathered that besides the colliery visited by the Team, there are many other collieries in the tract, which are situated under almost identical geological conditions and are continuously pumping out water. The names of these collieries as given at site, are mentioned below :—

1. Mahangkali colliery	}	.. .. .	Located near Chanda.
2. Rayatwari colliery			
3. Lalpati No. 1 colliery	}	.. .. .	Located at Ballarshah
4. Lalpati No. 2 colliery			
5. Ballarshah colliery	.. .. .	.. .. .	Do.
6. Sasti	.. .. .	.. .. .	Located at Ghugus.
7. Ghugus	.. .. .	.. .. .	Located at Majir.
8. Majir	.. .. .	.. .. .	

The total area under lease with these collieries is stated to be in the neighbourhood of 10,000 acres. A large percentage of this area and adjoining areas, it is felt, can be utilised for agricultural production,

*Refer to Appendix XIV of the Report (November, 1959) of the Committee on Plan Projects, Minor Irrigation Team, on minor irrigation works in Madras State.

particularly with the help of water so readily available. The Planning Commission accordingly addressed the State Government to set up a Pilot Project for utilisation of that water. A copy of Planning Commission's letter is given in *Appendix VI*.

4.28. The question of utilisation of affluent from collieries or other type of mining operations is of a wider significance, particularly when there is need to utilise water supplies available even in small quantities, to increase our agricultural production. Such water, wherever it is found suitable for agricultural use, should be made use of, if lands in the neighbourhood are, also suitable for the purpose.



CHAPTER V

Wells and Lift Irrigation

5.1. In the Deccan Plateau area, there is not a continuous steady water table. Exact location of the water seams from which wells derive their supply cannot, therefore, be indicated with certainty. Wells sunk in the region have to some extent to be excavated in rock, except where rock level happens to be low.

5.2. Since the general geological formation of agricultural areas in Maharashtra is such that soil depths are poor, ground water is mostly held in fissures of murum pockets within the sub-surface. There being very limited layers of aquifers, well irrigation, as practised in the tract for centuries, therefore, does not hold much promise. In hot weather domestic need of water is, by and large, met from 'nistar' tanks which exist in a large number of villages. Even these tanks go dry in years of drought.

5.3. Cost of sinking wells in the Deccan varies from Rs. 3,000 to Rs. 5,000, and normal total well is about 40 to 50 feet deep. Water is struck at a depth of about 25 to 40 feet. Wells not within the commands of irrigation canal have normally the capacity to irrigate between 3 to 5 acres. Supplies in the wells dwindle down towards the middle of March and quite a number of wells go dry by the end of April, giving barely drinking water supply, till the end of hot weather.

5.4. Thus, an irrigation potential of mostly seasonal nature with an unreliable supply of water only is possible with a capital outlay of about Rs. 3,000 to Rs. 5,000 for serving an area ranging from 3 to 5 acres. Cost per acre for well irrigation, therefore, comes to about Rs. 1,000 to Rs. 1,600. Recurring expenditure has also to be incurred on providing lifting equipment and the power to lift water either mechanically or manually. Well irrigation is, therefore, a costly mode of irrigation, more so, when certain wells are found incapable of striking water, or yield inadequate supply.

5.5. To help the well, in some areas percolation tanks are constructed in the upper reaches of a stream to store water, and enrich the sub-soil water resources by percolation. Water from such percolation tanks finds its way in the seams in the underground rocks.

5.6. One such tank was visited by the Team at Dhakale in *taluka* Baramati. The old earthen bund was raised by 4 feet in the year 1952-53 to increase the capacity of the tank from 2.5 Mcft to 6 Mcft., at a cost of Rs. 22,290. The tank has a catchment area of 248 acres and the average annual rainfall of the tract is 19 inches. About 120 acres area, spread on 28 wells on both banks of the present *nala* in the periphery of about 3 miles is stated to have been benefited.

5.7. Later, in the year 1955-56, to augment the storage in the tank, a proposal to divert water in the adjoining catchment was examined. Accordingly, a feeder channel was excavated in the year 1956-57. The work was carried out as a scarcity work. This resulted in an increased capacity of 2 Mcft. Another 40 acres could be benefited thereby.

5.8. Well No. 2, situated about $\frac{1}{4}$ of a mile below the dam site was examined in some detail. Some of the owners and cultivators of the well were present. They stated that water table in the well corresponds directly to the quantity of supply in the tank. Since renovation and raising of bund in 1952-53, marked improvement of water in the well has occurred. Prior to renovation, the well used to be emptied after 4 hours working and now a *mothe* can function for 8 hours continuously, which proves the efficacy of percolation tanks.

5.9. Since water resources of the State are limited, scope of irrigation schemes in scarcity areas is by no means large. Soil conservation measures to prevent erosion and conserving moisture are more effective than even percolation tanks. The State Authorities have drawn up a phased programme of contour-bunding. Out of 329 lakh acres bundable area of the State 17,30,817 acres area had been bunded till November 1960. In the Third Plan Period, 25 lakh acres area will be taken for bunding. Cost per acre of contour bunding is Rs. 45. The Team during their tour saw great activity in this respect, particularly in Ahmednagar area. It was, however, observed that the contour bunding has been done in the field by taking earth from pits just by the side of the bund. It would seem better if earth is taken in triangular wedge shape, so that a ditch is not created very near to the bund. The result would be, that water would spread out on a wider area and will soak in faster, besides the ground can be cultivated even to the toe of the bund.

5.10. Contour bunding and *nala* plugging programme has already given some fillip to the construction of new wells and renovations of old ones. From the year 1957-58 to 1959-60 new wells numbering 20,725 are reported to have been constructed, and repairs have been carried out to 9,193 old wells. In the Third Plan Period 64,200 new wells are proposed to be sunk and 32,000 old wells repaired.

5.11. Wells, as already said, play an important part in the irrigated agriculture of the State. Their district-wise picture and performance in the year 1956-57 is given in the *Appendix I*. Figures for the State taken as a whole are reproduced below :—

Table showing No. of wells in use and out of use with their Performance in 1956-57

Total No. of Irrigation wells	No. of wells in use	No. of wells not in use	Percentage of wells not in use to total No. of wells in Col. 1	TOTAL IRRIGATED AREA		Percentage of area irrigated by wells to total area, in Col. 5	Average Area irrigated per well (acres)
				All sources (acres)	Wells (acres)		
1	2	3	4	5	6	7	8
5,76,014	4,63,928	1,12,086	19.46	22,62,200	11,71,600	51.79	2.3

Thus out of 22,62,200 acres total irrigated area from all sources, contribution of wells is 11,71,600 acres, which comes to 51.79 percent and average area irrigated per well is 2.3 acres. It will also be observed, that

at the end of the year 1956-57 out of a total of 4,63,928 wells in the State, there were as many as 1,12,086 wells out of use. During the subsequent three years only 9,193 old wells were taken up for repairs. The target to repair 32,000 wells in the Third Plan Period may be inadequate compared to huge number of repairable wells. More emphasis need to be given to the renovation of old wells in order to re-create the lost potential at a much lesser cost compared to sinking of new wells. Their condition may be bad already, and if further neglected some of them may be beyond repairs. The Team feels that well sinking and renovation schemes side by side with soil conservation programme should be progressed vigorously so that position of irrigated agriculture in the State improves.

5.12. Wells, however, need to be sited after thorough examination of the sub-soil resources of water. The Team learnt, that in a particular area in Wardha district, large number of electric connections were sanctioned for pumping sets. This large-scale pumping water may affect adversely on the sub-soil water supply, as it may lower the water table to the disadvantage of those who operate their wells with bullock *mothes* only. Such sanctions need, therefore, to be accorded after due study of sub-soil supplies and with caution and restraint.

5.13. Extraction of water from wells with the help of bullocks is a time old practice in the country. The Team was, however surprised to see, that with the downward movement of the bucket, bullocks in Maharashtra State are made to retrace their steps upslope. The leads may be short and the animals may even get used to it, but the practice is unnatural and enervating. This aspect of animal efficiency and preservation thereof deserves attention not only of bullock owners, but of the State Authorities as well.

5.14. *Mothe* system has been replaced by Persian wheels on a large number of wells in the Punjab and Uttar Pradesh. In the State of Maharashtra, where recuperation in the wells is slow, Persian wheel may not be a suitable replacement for *mothe*. An alternative to the Persian wheel may, however, be evolved and popularised so that bullock power is used with greater efficiency. Many types of such animal operated lifting devices have been evolved which can be adjusted to suit local needs after necessary experimentation on a few wells in the State.

5.15. The Team visited Loni areas served by Mutha canal. This system was built in about 1920. A number of sugar factories have come up in these areas. To fight the menace of water logging, pumps were installed and drains dug. With these measures water table which was about 2 feet below ground is now held at 15 to 20 feet below ground. Another reason of lowering the water table was sinking of new wells. It was stated that in the year 1943 there were hardly half a dozen wells in the area, which now number about 1,400.

5.16. Shri Vika Patel, Chairman of Loni Co-operative Sugar Mill stated that provisions of Section 48 of the Bombay Irrigation Act, 1879, under which water rates are leviable for irrigation done by means of a well sunk within two hundred yards of any canal after the admission of water into such canal, acted harshly on irrigators. Percolation from the canal provides almost a perennial supply to the wells in its close proximity (reasonably fixed under Section 48), and the Team feels, there is justification for the Government to charge "Royalty" on use of water from such wells.

LIFT IRRIGATION THROUGH CO-OPERATIVE SOCIETIES

5.17. Apart from open wells, another system of irrigation that could be adopted in Maharashtra is through a process of lifting water from innumerable rivers and streams, which flow practically in all parts of the State, though with greatly varying discharges. This lift irrigation involves joint or corporate action on the part of beneficiaries as the lifting installation is beyond the capacity of individual cultivators.

5.18. The Co-operative Department of the State Government, therefore, organised Co-operative Lift Irrigation Societies during the past decade. The number of such societies at the time when the Team visited Maharashtra was 122. Each of these societies has to raise share capital from its members to the minimum extent of 25% of the capital cost of the scheme (out of which 15% must be raised before the society can be registered and the remaining 10% before the Government's financial assistance is sanctioned and disbursed to each society). The societies, which satisfied these conditions were held eligible for financial assistance from the Government on the following scales :—

- (i) 50% of the capital cost of the scheme to be given on long term loan repayable with interest at 4½% per annum within a period of 15 years, the first instalment being due one year after the actual commencement of irrigation. This loan is to be secured by mortgage both of machinery purchased and the amount of the members' land valued at twice the amount of the loan.
- (ii) 25% of the capital cost to be given as subsidy.
- (iii) 15% of the capital cost may be advanced as additional loan to enable the society, which has completed its scheme, to meet its working and operational expenditure. This additional loan also carries the interest of 4½% per annum. It is to be repaid in five annual instalments, the first instalment being due one year after the disbursement of the loan, and is to be secured by charge on the general assets of the society, additional security being taken in the form of mortgage of land valued at twice the amount of loan.
- (iv) A subsidy towards the cost of appointment of a trained Secretary-cum-driver at the rate of Rs. 900 is to be given for the first year and Rs. 450 for the second and third year.

5.19. These maximum limits of subsidies and the amounts that may be granted to the society would be governed by the expenditure actually incurred by it, subject to the maximum limits.

5.20. The schemes were prepared with due consideration being given to different aspects like location of the site, approximate irrigable area, the source from where the water is to be pumped out for irrigation, approximate lift involved, annual high flood level and extraordinary flood level of the *nalla* or stream, and the site of the pump house itself.

5.21. The Team gathered that some of these societies were unable to function efficiently, because sufficient quantity of water was not available, as the stream had earlier irrigational and riparian commitments, which could not be tampered with. Also, the commands were overstated, which

could not be served with the water available. The alignments of channels were not done in a settled manner and had to be shifted now and then to suit individual requirements. Above all, the management could not mobilise the required co-operative spirit, which alone can impart a disciplined attitude on the part of all the share-holders and proper roastering of supplies, enforced through *Warabandi* or *Osrabandi* systems in operation on canals in the Punjab and Uttar Pradesh. Besides, a planned out irrigated agricultural pattern is essential in such undertakings so that, limited water is distributed equitably to all concerned according to their areas and times fixed therefor. The maintenance of the equipment also requires an organised agency to look after it. Leaving the equipment to the individual co-operative societies with limited technical resources could not lead to efficient working.

5.22. The Team had occasion to look into the actual working of Wajai Co-operative Lift Irrigation Scheme*, located on the left bank of Mutha river in village Manjri Khurd, taluka Haveli, district Poona. This

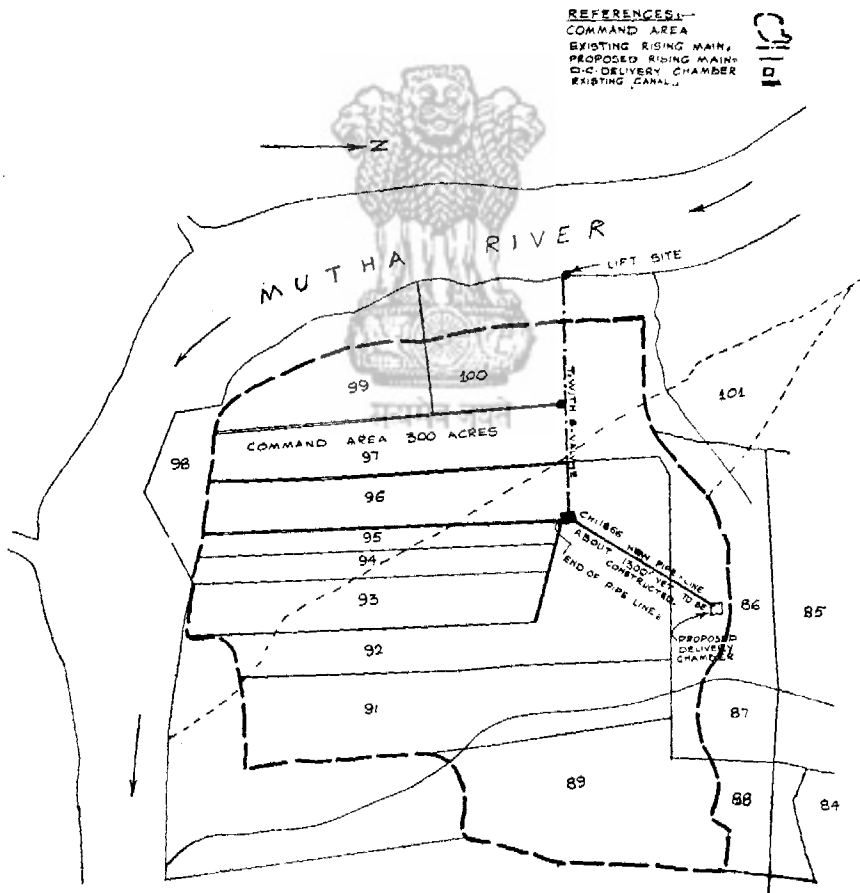


FIGURE 5.1

*This installation is reported to have been badly damaged during the recent floods in Mutha river after the collapse of Khadakwasla. The engine house was washed away.

Society was organised in the year 1953 and scheme to irrigate an area of 300 acres was sanctioned at an estimated cost of Rs. 93,562.

5.23. Actual irrigation figures from the year of functioning of the scheme are given below :—

	1st year 1958-59 (acres)	2nd year 1959-60 (acres)	3rd year 1960-61 (acres)
(i) Sugarcane	30	30	15
(ii) Rabi & Kharif	18	18	10

The performance falls short of the envisaged target viz. 300 acres and is attributed to the following reasons :—

- (a) The delivery chamber (Shown in Survey No. 86 in the Plan Figure 5.1) has not yet been constructed, as it remained undecided whether it was to be connected with the end of the pipe line at chain 1,866 by a surface channel or underground pipe line. Decision has since been taken to lay about 1,300 feet pipe line at a cost of Rs. 18,078. Cost of the Delivery chamber is already included in the original estimate. With the completion of these two items, it is hoped that nearly 150 acres in addition to present irrigable 60 acres would come under irrigation.
- (b) The two "KARMA" cold starting engines of B.H.P. 32-35 each, installed in 1956, have never worked simultaneously. One of the two engines had been constantly out of order for one reason or the other, and the other engine too had to stop functioning twice or thrice in a month for repairs. Two/three days stoppage of work each time is necessary as spares required for replacements and repairs are not readily available.
- (c) The two engines are located away from the pumps and both are connected by a set of drive belts. The distance between the pump and engine is about 35 feet horizontally and 8 feet vertically. This is not a very efficient system.
- (d) The engines, which could lift hardly 75% of their designed capacity even when they were just new, can render 50% service now, due to defects in machinery. Thus where two engines should have worked with full efficiency for the whole month, only one engine works with hardly 50% of its designed efficiency for about 24 days in a month, resulting in barely 20% output. Due to defects in the machinery, consumption of oil is also on the increase day by day, with same hours of working per day.
- (e) The water courses are clogged up by grass growth and need to be dressed.
- (f) Due to the rising cost of irrigation, some of the members of the Society (about 25%) are not in a position to pay for it,

It being famine-stricken area, resources of the cultivators are limited and the scheme is running in loss.

5.24. Judging from what the Team observed, it appears that delay in the completion of the schemes acts as a drag on the morale of the members of the Co-operative Societies, apart from the fact that such undertakings involving technical know-how of pumping scheme need to be streamlined in their operation before they can be operated efficiently by layman agencies like Co-operative Societies. The Team, therefore, feels that State technical agencies may handle the Schemes for a couple of years before making them over to co-operative societies. That system may produce better results than what has been possible so far.



CHAPTER VI

Agricultural Aspects

6.1. General.—Agriculture in Maharashtra depends predominantly on the vagaries of monsoon. Production is low, being only about 6 million tons of all cereals and pulses, for a population of $39\frac{1}{2}$ millions and per capita holding of 1.9 acre against an average of 0.9 acre for whole of India. After making an allowance for seed, wastage etc., at the rate of $12\frac{1}{2}$ per cent, this gives an over-all average daily supply of only 14.8 ounces per adult equivalent, which is far short of standard requirements. Thus, in spite of higher acreage per capita, the basic problem of the State is still that of producing enough food for her growing population and providing enough raw materials and commercial crops to meet the needs of industries and export.

6.2. Scope for lateral growth.—The steps which are needed to raise agricultural production are all well known. Of these, greatest attention is to be paid to intensive measures, though the scope for lateral growth of agriculture must also be fully explored. The land utilization figures of the State indicate that apart from the net area sown which forms 58.4 per cent of the total geographical area, nearly 7.8 per cent is under 'fallows' (Current and others), 4.8 per cent is under permanent pastures and grazing lands and 2 per cent is culturable waste. All the waste lands are not easily reclaimable as some of them are highly eroded or infested with injurious salts or lie in places where rainfall is inadequate and possibilities of extension of irrigation are meagre. Then, there are also soils under the tidal influences which show high contents of exchangeable monovalent bases of magnesium and predominance of chlorides in total salts. These lands can be reclaimed at a considerable expense. 'Fallow' lands and to some extent pastures and grazing lands also offer some scope for the enlargement of area under crops. The Team learnt that in some of the coastal areas, a form of 'Shifting Cultivation' is practised under which a crop is taken from a piece of land every third year. This is rather wasteful exploitation of land and it seems necessary to draw up a realistic programme for constructive land use and encourage the farmers to adopt proper methods of fuller utilization of such lands.

6.3. Cropping pattern.—In Maharashtra, great variety of soils and climatic conditions are met with, which have largely influenced her cropping pattern. The principal crop of the State is *Jowar*, which covers 14 million acres or 30 per cent of the net area sown. It is grown all over the State excepting the coastal areas, the maximum area being in Poona and Aurangabad Divisions. Ahmednagar, Satara and Poona grow mostly *kharif jowar*. The next food crop in importance is *bajra* which is grown over an area of $4\frac{1}{2}$ million acres. Most of it is raised on shallow light soils in Poona Division, Khandesh and Nasik. It is entirely a dry crop and at some places, it is grown mixed with *tur*. Rice is the third cereal crop comprising three million acres. It is mainly grown in Chanda, Bhandra

and coastal districts where rainfall is heavy. Wheat is entirely a *rabi* crop and is grown over an area of 2.25 million acres. It is chiefly grown in Nagpur and Aurangabad Divisions and Nasik, East Khandesh and West Khandesh districts. Maize is comparatively an insignificant crop. Amongst the cash crops, cotton occupies the largest area (6.5 million acres), followed by groundnut (2.8 million acres). While cotton is almost entirely grown in Nagpur and Aurangabad Divisions, groundnut is mostly produced in Aurangabad and Poona Divisions. Sugarcane plays an important role in the agricultural economy of the Poona Division, the maximum area under this crop being in Ahmednagar followed by Kohlapur. Chillies is yet another cash crop grown over an area of 3.5 *lakh* acres. The area under fruit trees is about 1,35,000, that under tubers (potatoes and sweet potatoes) is less than 50,000 acres.

6.4. Paucity of irrigation is one of the main reasons for the predominance of millets in the cropping pattern of Maharashtra State. Only 2.26 million acres out of 44.29 million acres of net area sown is irrigated. This gives a percentage of only 5.1 as against an All-India figure of 18 per cent. Most of the area, nearly 70 per cent, is irrigated by wells, tubewells and tanks and the rest by canals and other sources. The present irrigation systems largely supply water to food crops, the most important being rice, *jowar*, wheat and gram. Most of the irrigated area of rice is in Bhandra and Chanda districts. Wheat is chiefly irrigated in Nasik, West Khandesh and East Khandesh, Sholapur, Ahmednagar, Satara, Osmanabad and Aurangabad. The largest irrigated area of *jowar* is in Sholapur and Ahmednagar with small areas in other districts of Poona and Aurangabad Divisions. Cotton, pulses and oilseeds receive very little irrigation; they are mainly raised as rainfed crops. Sugarcane is almost entirely grown under irrigated conditions. The Team observed that while in *kharif*, water is applied by the cultivators to such crops as rice, *jowar* etc., only when absolutely necessary, in winter apart from wheat and to some extent other food grains, it is utilized for growing high valued crops like sugarcane, fruit trees, fodders, vegetables etc. It was also noticed that maximum number of wells were found in areas which have also the facility of canal irrigation. This is because of percolation of water from the nearby canals and water channels. At such places, sugarcane is the principal crop. From the major crops irrigated in the State, it is clear that the cropping pattern under irrigation has changed only to a small extent, the main crops irrigated being rice, *jowar*, wheat and fodder which also are the major crops under rainfed conditions. In spite of pressure of population on land, double cropping is followed only on a small area, the area sown more than once for the whole State being only 1.8 million acres or four percent of the gross area sown. The Team, however, observed that in Nasik, although the percentage of irrigated area to total cropped area is less but the irrigated area appears to be better utilized inasmuch as larger proportion of vegetables such as onions, chillies, grapes, are being grown and almost all irrigated area is double cropped. Irrigation of wheat is also quite popular there as it fetches higher price than *jowar* and *bajra*.

6.5. Production of Important Crops.—Total production of principal crops in Maharashtra from 1951-52 to 1958-59 is given in Table 6.1.

TABLE 6.1

("000" Tons/bales)

Crop	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59
<i>Jowar</i>	2,277	2,191	2,608	3,090	2,296	3,016	3,008	3,256
<i>Bajra</i>	389	267	532	506	439	440	492	453
Rice	907	955	1,115	1,153	1,180	1,191	1,170	1,269
Wheat	245	203	275	368	393	322	294	413
All Cereals ..	4,052	3,855	4,811	5,405	4,578	5,258	5,225	5,661
Pulses	931	769	1,131	982	917	898	801	856
Cotton	1,145	868	1,131	1,093	764	1,237	1,333	1,184
Groundnut ..	535	416	633	834	707	753	612	636
Sugarcane ..	617	523	530	623	662	777	730	716

It will be observed that rice production has consistently increased and in 1958-59, it was higher than 1951-52 by 3.62-lakh tons. In spite of some recessions in a few years, production of *jowar*, *bajra* and wheat is also showing an upward trend. In other crops, there were appreciable fluctuations from year to year. The year 1958-59, on the whole, was a good year with level of all cereals production at 5.7 million tons which was higher than 1951-52 by over 16-lakh tons. These figures also show that while the production of pulses has decreased, that of cotton is more or less stagnant. Groundnut and sugarcane production show an increase of 19 and 16 per cent respectively. During the Third Five Year Plan, it is expected to increase production of rice, wheat and millets and other cereals by 7.63-lakh tons, 1.74-lakh tons and 7.69-lakh tons as against the estimated requirements of 6.20-lakh tons, 9.52-lakh tons and 9.29-lakh tons respectively. In cotton and oilseeds, not much increase is expected. Thus, even at the end of the Third Five Year Plan, this State will be far from achieving self-sufficiency in food grains, cotton and oilseeds. On the other hand, in sugarcane, it will be surplus. Thus the position in regard to wheat, cotton and oilseeds requires to be re-assessed. No doubt Maharashtra is not so well suited for wheat production as Punjab and Uttar Pradesh, yet by evolving suitable high yielding rust resistant varieties and extension of irrigation in suitable areas, it should be possible to step up the production of this crop appreciably. There is also a great scope for increasing cotton production in the Nagpur division by making water available in the summer season which will make it possible to advance its sowing from June-July to April-May. Experiments conducted by the Agriculture Department indicate that by sowing cotton crops early with the help of irrigation, the cotton yield is doubled and even trebled.

6.6. Yields per acre.—The average per-acre yield of the major food grains and cash crops of the State as compared with the All-India figures are given in Table 6.2.

TABLE 6.2

Crop	Average yield per acre in lbs. for eight years (1951-52 to 1958-59)		Percentage of Col. 2 to Col. 3
	Maharashtra	All India	
1	2	3	4
Rice	863	747	115
Wheat	353	644	55
Jowar	437	404	108
Bajra	220	273	81
All Cereals	442	574	77
All pulses	335	429	78
All food grains and pulses	422	544	78
Cotton	68	86	79
Groundnut	562	664	82
Sugarcane	6,362	2,882	221

It is evident that average yield of sugarcane is nearly 2½ times that of All-India average. Yields of other crops excepting *jowar* and rice, are much lower than All India averages.

In the case of wheat, it is only 55 per cent of the national average while for *bajra*, pulses, cotton and groundnut, the corresponding figures are 81 per cent, 78 per cent, 79 per cent and 82 per cent, respectively. It is obvious that there is a great scope for raising the crop yields in this State, by large-scale adoption of improved agricultural practices and intensive methods of cultivation including assured water supply. The standard per acre yields of irrigated and unirrigated crops of rice, wheat, *kharif jowar*, *rabi jowar*, *bajra*, pulses, sugarcane and cotton as given in the season and Crop Report of Maharashtra State for the year 1956-57 show that there is no difference in the standard yields of Rice in the irrigated and unirrigated areas, in any of the 20 districts for which these figures have been given. Same is the case in respect of *bajra* and pulses. In wheat, *Kharif jowar*, *rabi jowar*, cotton, however, the standard yields for irrigated areas, as expected, are much higher than those of rainfed crops. The comparative average figures for the districts concerned are given in Table 6.3.

TABLE 6.3

Crop	Average standard per acre yields in lbs.		Districts
	Irrigated 2	Unirrigated 3	
1	2	3	4
Wheat	1,151	506	West Khandesh, East Khandesh, Nasik, Ahmednagar, Poona, Sholapur, North Satara, South Satara, Kohlapur, Buldhana, Wardha, Akola, Nagpur and Chanda.

TABLE 6.3—*contd.*

1	2	3	4
<i>Kharif Jowar</i> :	1,500	633	North Satara, South Satara and Aurangabad. The standard yields in other districts as given are the same for irrigated and unirrigated areas.
<i>Rabi jowar</i>	1,275	388	Ahmednagar, Poona Sholapur, South Satara. The standard yields in other districts as given are the same for irrigated and unirrigated areas.
Cotton	343	99	West Khandesh, East Khandesh, Nasik, Ahmednagar, Poona, North Satara and South Satara. In the districts of Nagpur, Wardha and Buldhana, the standard yields as given for the irrigated and unirrigated areas are the same.

The low overall per acre yields in the State are attributed to the dependence of agriculture on rainfall which is not only seasonal but varies greatly from place to place and year to year. Further, in almost the entire State, there is long spell of practically dry weather during winter and summer months. The scope which irrigation offers in *rabi* season is, therefore, quite obvious. In the case of wheat, the above statistics show that in spite of natural handicaps, fairly good yields can be obtained with irrigation. This is a redeeming feature as the State is heavily deficit in the food grains.

6.7. Land improvement.—Soils can be made more productive by preventing their erosion and by improved management of the rainfall. In fact, the State is quite alive to the situation and Maharashtra is the first State in India which started large-scale contour bunding, trenching, gully plugging, afforestation *etc.*, in Bijapur and Sholapur districts as early as in 1943 to improve the eroded lands, check run off and erosion. Since then, considerable work has been done. The Team was gratified to see this work while travelling through parts of Poona and Ahmednagar districts. As a result of this work as also the introduction of Dry Farming method over thousands of acres, crop yields have increased considerably. Since most of the lands in the State are undulating and subjected to severe erosion, this work, however, requires to be expanded a good deal especially in areas which can be served by minor irrigation schemes. This is essential in

improving the underground water resources of the State. As a matter of fact soil conservation and such programmes of minor irrigation works as well sinking, should go hand in hand. In regard to dry farming method, it was observed that there is yet a lot to be done in popularising the recommended practices, as still most of the cultivators have not taken them up.

6.8. Land levelling.—For the efficient utilization of water, it is necessary that the lands which receive irrigation, must be properly developed with field channels at appropriate places. In order that water may be applied uniformly at every place in the field, the levelling of land within the border deserves special attention. The Team, however, noticed that in the case of irrigation works such as *Bandharas* and diversion channels *etc.*, fairly large-sized uneven fields were being irrigated by flooding, with the result that while high spots were not receiving sufficient water, the low spots were being over irrigated. In those parts of the fields where moisture is inadequate, the production is bound to be low, whereas concentration of water in low spots may cause severe damage to crops as also to soils by raising water level. The position, as seen, at present is mainly due to the fact that the responsibility of development of land to be irrigated is left entirely with the farmers themselves. The conversion of dry land into irrigation land requires lot of labour and capital and even special equipment. It will improve the matter a good deal if the farmers are supplied with graders and land levellers and they are also extended adequate credit facilities for land development. It was also noticed that the water in rice was distributed from field to field and for want of irrigation channels, no second crop after rice was taken. This is, indeed, very wasteful and requires to be taken care of.

6.9. Crop rotation.—The fertility of the soil can best be built up and maintained by growing crops in a carefully planned sequence. In Maharashtra, in view of the predominance of millets in cropping, most of the prevalent rotations centre round these crops. In the black cotton soils, the common rotation is cotton-*kharif jowar*, though to some extent such crops as wheat, gram and sesamum are also grown after cotton. In the groundnut areas, usually this crop is grown alone but sometimes it is inter-cropped with cotton, linseed, sesamum and castor. It is quite common to grow *tur* with cotton and *jowar*, and on rice fields *bunds*. Sometimes wheat follows groundnut. This is a good rotation. Rice, as already stated, is grown in heavy rainfall areas and usually it is raised year after year on the same land with a ploughed or bare fallow between successive crops. In Chanda, no second crop after paddy is taken as cultivators devote their time to non-agricultural pursuits connected with *biri* manufacture. In *kharif* season, millets are usually sown mixed with one or more pulses such as *moths*, *mung*, *urd*, field beans, horse gram and oilseeds. Under irrigation, even such crops as brinjals, *bhindi*, cucumber, chillies are grown mixed with them. Gram or any other *rabi* pulse after rice or *jowar* is a desirable practice but it is followed only to a small extent. *Jowar*, which is the main crop of the area is a heavy feeder on plant nutrients and leaves a depressing effect on the succeeding crops. This effect can only be overcome by adequate manuring, fertilization and inclusion of legumes in the rotation. Experiments conducted at the Central Rice Research Institute, Cuttack, Orissa, have shown that it is possible to step up rice production by 21 per cent by raising on the same land two crops of rice in a year, and by 64 per cent and 81 per cent by adopting the rotation, "Dhaincha (Greenmanure)-Rice-Rice" and

"Mung (Greenmanure)-Rice-Rice" respectively. Thus, in rice growing areas, stress is to be laid on the introduction of legume crop for green manuring either before or after rice. Apart from green manuring, the growing of legume as such is a desirable practice for the maintenance of soil fertility. In Maharashtra, pulses are quite commonly grown mixed with millets and other crops. In recent years, in the black cotton soils, groundnut has been introduced in the rotation and the recommended rotation now is *Jowar* (or wheat)-groundnut-cotton. At Wardha, the Team observed that good wheat crop after rice had been obtained but rice followed by leguminous crop would be a better rotation.

6.10. Research on crop planning and water lifts.—Unlike dry farming, which in Maharashtra, has received systematic and scientific approach, the problem of irrigated farming has not yet received adequate attention in this State. While at the Engineering Institute, Nasik, mainly engineering problems such as designing of channels, planning of canals, evaporation losses, rate of infiltration, drainage, soil texture, soil physics *etc.* are dealt with, the information available with the Agriculture Department in regard to water requirements of crops and crop rotations is scanty. Agronomic experiments conducted under the aegis of Indian Council of Agricultural Research have yielded a mass of useful information with which it is possible to establish basic facts but much needed research on crop rotation and methods of irrigation is virtually lacking. It is imperative to undertake these studies on a systematic basis as the problem of reducing time lag between the completion of works and realization of full benefits is vital one and calls for agricultural measures in respect of new crops and rotations *etc.* It is not only the total amount of water required for the growing of principal crops that governs a cropping scheme but it is also the water needs of plants at the critical periods which have to be considered. Thus, for different areas, separate schemes for cropping have to be worked out keeping in view the water available and the soil conditions prevailing there. There are also large areas in the State which are suitable for the growing of tuber crops. At present, potatoes are mostly grown in Poona, North Satara and to some extent in Ahmednagar and Nasik. Although this State has three times the area of West Bengal, yet area under potatoes is only 1/4th of what it is there. Apart from area under this crop, there is a great possibility of growing sweet potatoes and tapioca. In China and even in U.S.A., these crops are cultivated on a large scale and enter in the diet of the people. Sweet potatoes have a number of advantages over potatoes; the chief amongst them being ease of propagation and less rigid requirements of soil, manuring and irrigation. Tapioca, which was introduced in South India with the object of relieving distress and as a substitute for rice, is now widely accepted as food material in Kerala and has been of considerable help in tackling the food problem of that area. It is a tropical crop and requires humid climate. It is very high yielding tuber and can stand heavy rain of even more than 100 inches, as well as considerable drought. Its cultivation deserves attention. Further, in Maharashtra, there is a great scope of increasing area under truck crops, oilseeds and hybrid maize, arecanut, coconut, cardamum, cashewnut *etc.* Thus research on crop planning has to be broadbased which must be undertaken by the Agriculture Department in close collaboration with Irrigation Engineers. For this purpose, it is necessary to set up State Research Station to deal with all problems of irrigation farming including the improvement of water lifts. In

respect of water lifts, the Team observed that in Maharashtra an age old device of lifting water by *mothes* from wells is still being extensively used. In some parts of Northern India, where *mothes* were in use about thirty or forty years back, they had been completely replaced by Persian wheels long ago. Large-scale replacement of *mothes* by Persian wheel in Maharashtra may not be possible due to inadequate and uncertain underground water supply but in areas where water supply is adequate and depth of water table is not much, there is a possibility of replacing the existing water lifts by more efficient devices. It should even be possible to make an improvement in the *mothes* where it is felt that they cannot be replaced by any other device. There is, thus, an urgent need of carrying out systematic research on the various types of water lifts. The Team also considered that for uneven lands, as found in Maharashtra, the feasibility of introducing sprinkler irrigation in some areas is also worth exploring at suitable places.

6.11. Farm Management Research.—In evolving a suitable crop rotation for an area, the first step is to select the crops to be grown and then decide how much of each should be grown and in what sequence and order, taking into consideration the local physical, economic and social conditions. The choice of crops and their combination to evolve a suitable rotation is, thus, not only a matter of agronomic research but also of Farm Management Studies. For that matter, therefore, a well-planned programme of Farm Management also requires to be drawn up in the State in connection with the agronomic research centres. The Indian Council of Agricultural Research has conducted such studies in Nasik and Ahmednagar which have revealed interesting facts but such studies require to be taken up in all important irrigated regions of the State.

6.12. Demonstration.—One of the causes of slow development of irrigation farming under irrigation projects, is unpreparedness of the farmers to receive water when it comes. Unless water is fully utilized as soon as it is received, the object of constructing irrigation works is to some extent defeated. Farmers used to dry farming have, thus, to be taught the technique of irrigation farming. In order to achieve this, it is necessary that there should be close association of the crop planning research centres and the Extension Organisation. While research centres will be engaged in investigating the problems of water requirement, drainage, method of water conveyance, methods of application to fields, preparation of land for irrigation, crop rotations and optimum size of beds *etc.*, the Extension Organisation must carry the results of research to the cultivators by carrying out systematic practical demonstrations of suitable cropping patterns. In respect of various practices recommended by them, the Department of Agriculture already attends to this work but in the irrigated areas, special attention has got to be paid to the demonstration of suitable cropping patterns in combination with improved agricultural practices like use of improved seeds, manures, fertilizers, implements, green manuring, plant protection measures *etc.* It is only then that the farmers will realize the extent of potential which irrigation offers. The Team learnt that the Department of Agriculture has started five demonstration-cum-trial centres in various parts of the State. This number is altogether inadequate and it is felt that larger number of such centres should be started to make a real impact on the cropping pattern of the irrigated areas.

6.13. Training.—Full utilization of water after any irrigation work has been completed, is of paramount importance. In order to reduce the time

lag between the creation of the potential and its fuller utilization, it seems necessary that both the Irrigation as well as Agriculture Departmental Field Officers and officials concerned with the programme should be given special in-service training in the basic problems of water utilization, crops that could be introduced in various areas and the sequence in which they can be grown for the maximisation of production and at the same time keep the soil in good shape. For this purpose, the Team recommends that training centres at some suitable Research Stations or Agricultural Colleges, where research on the evolution of cropping pattern is taken up, should be started both for the officers of the Agriculture as well as Irrigation Department. There is also need to strengthen the curricula and courses at the Engineering and Agricultural Colleges in regard to soil and water conservation and irrigation farming. All these measures are necessary so that the staff concerned with the development of irrigation may be able to guide the farmers in improved irrigation practices and cropping patterns.



CHAPTER VII

Planning and Prospecting of Minor Irrigation

7.1. While studying the minor irrigation works in the State, it has been observed that a comprehensive survey of the potential of minor irrigation works both State-owned and private, has not yet been done on district or even Block-wise basis. As a result, the schemes are generally taken up on an *'ad hoc'* basis. Priorities can be correctly fixed, only when the overall picture of the resources is in view. This overall survey of the likely schemes may not be possible on a detailed basis, all at once.

7.2. It is, however, felt that a beginning has to be made for a comprehensive ascertainment of irrigation resources available, whether major, medium or minor. Major and medium schemes can be located in river basin studies as has been done in the case of Bhima river, a draft report of which, the Team had occasion to look into. Minor Irrigation works in isolated pockets of land, which cannot be served except from strictly localised schemes do not form part of these studies. They have to be located on a somewhat different basis, taking into consideration the ground water availability as well.

7.3. A Block-wise ascertainment of such resources ultimately compiled into District maps, will eventually reveal the picture of irrigation resources for the State as a whole whether major, medium or minor, State-owned or private, in a better perspective than what has been possible so far. Recommendations to that effect had been made in the past in different Regional Minor Irrigation Conferences; in the Annual Conferences and in the Annual Conference of Community Development held at Srinagar in 1960. But no headway has been made in that direction so far. The Team feels, that there is distinct need for comprehensive planning and investigation of all irrigation possibilities at District level. Particular attention of various State authorities has been drawn to this important aspect of resource ascertainment in Planning Commissions' circular letter No. 3-2(7)/61-Agri. of October 21, 1961, addressed to Development Commissioners of the States (*Appendix VII*).

7.4. As a practical measure, this comprehensive survey may include locating minor irrigation works like tanks, diversion canals, lift irrigation works, tube or percolation wells. These maps may indicate such works as are estimated to irrigate more than a particular acreage, say 100 acres. In regard to the rest, only the total available quantity of water and the estimated area to be irrigated under each category of works in a Block area or a District may be shown. The works may also be listed in separate categories, because quite a number of them cannot be justified strictly on the grounds of financial returns, but which are recommended for execution as relief works, as and when the need for them arises.

7.5. A programme for undertaking minor irrigation survey and location of different types of possible works may be pursued on a priority basis, so that it could dovetail into the investigations that are being made at present

for major and medium irrigation works and there is no overlapping in planning of State irrigation projects. That will ultimately result in a comprehensive irrigation plan, being evolved for the entire State.

7.6. While co-ordinated activity is called for planning of irrigation works, a re-organization of the existing set-up for execution and maintenance of minor irrigation works is also warranted. Works in charge of Revenue Department, should gradually get shifted to the charge of village *Panchayats* or *Gram Samities*, who may be provided with necessary technical competence to look after them.

7.7. The State of Maharashtra has been carved out after amalgamations, re-organisation and bifurcation of the erstwhile Bombay, Madhya Pradesh and Hyderabad States. The Canal enactments and procedures of the various States are being applied in the respective regions thereof, now forming part of Maharashtra State. There is wide variance in the water usage and rate structure also. The Team, feels that the State Government may take early steps to evolve and enact a unified Canal Code for the State as a whole, so that disparities which reflect adversely on the agrarian economy of the State, are mitigated as far as possible. Such enactment should take care of both, surface and ground water resources of the State, and should be flexible enough to permit phased development of irrigated agriculture to replace the existing one crop dry farming presently practised in vast areas of the State.

7.8. In areas where ground water is intended to be exploited through mechanical pumping, it is essential to keep a watch on sub-soil supply. Its level should not be allowed to fall so as to adversely affect supplies on such open wells in the locality as have no pumping facilities. In other words, sub-soil supplies should not be exploited beyond their normal yearly recuperation assisted by artificial re-charging, if that be possible in specific locations. In any case, a study of the behaviour of sub-soil water table is of importance. Reference marks may be fixed on selected wells along specified lines of observations. Water depths in these wells may be observed at least twice a year i.e. one before rainy season and one after rains are over. Such data collected over a few years will indicate the behaviour of water table, whether there is excessive depletion or water-logging. It will also provide a criteria of determining the extent to which pumping could be resorted to from wells for irrigational purposes.

7.9. In the coastal strip of Maharashtra along Arabian sea, there are some alluvial stretches ranging in width from 2 to 10 miles. They are generally fertile. The general characteristic of the western slopes is that there is good rainfall during monsoon months, but post-monsoon flow is practically nil. For that reason mostly one crop is grown. There is, therefore, little prospect of *rabi* cropping except in certain reaches where there are laterite formations in upper slopes, which can retain some water. In some areas, however, water level is only 10-12 feet below ground level. Possibilities of exploitation of deep sub-soil resources through tubewell pumping need therefore to be explored. That may enable *rabi* cropping to be introduced on a perennial water availability basis and may as well help development of reclaimed *Khar* lands in coastal areas. Size of these tubewells could be determined by actual experimentation, as also the area that could be commanded by each unit.

The exploratory Tubewell Organisation could with advantage take up selected area in the tract for a few trial bore testings. There being increasing demand on the available water for industrial purposes on the Western slope area, the exploration may reveal some additional sources of water and thus relieve any likely strain on the existing minor irrigation resources of the tract.

7.10. Another possibility of improving irrigation facilities in the coastal strip lies in terracing the slopes in suitable reaches, where water could be held up during rainy season. This water could be gradually released after rains are over, thus adding to the post-monsoon flow of the concerned streams. The emergent area on upper contours could, thereafter, be sown with *rabi* crop. The Team feels that some Pilot Projects of this nature could be tried in these areas, which are at present water-starved during winter months.

7.11. A composite system of irrigation from surface storage-cum-ground water resources may be adopted in areas, where holding capacity of ground water supplies is limited owing to geological formations. In such areas, ground water supplies may be used up before applying the surface storage reserves. That will enable the water resources being used up over a longer period and may lead to a more profitable irrigated agriculture than otherwise possible, in some of the areas served by minor irrigation schemes.

7.12. An integrated soil conservation-cum-minor irrigation works programme allied with other measures of land amelioration and improved agriculture alone can progress irrigated agriculture in vast areas of Maharashtra. Detached schemes may not be able to improve conditions, as has been the experience in many cases. Fortunately Maharashtra State authorities are alive to this important aspect of agricultural development. The Team, however, feels that ever increasing stress needs to be laid on such an integrated and co-ordinated approach.

Recommendations

Among the States of India, Maharashtra has the lowest percentage of its cultivated area under irrigation. Its rainfall pattern also varies considerably from West to East. While the rainfall in the Ghats area is heavy, there is scarcity of water on the plateau to the West. The water and soil conservation schemes supplemented by minor irrigation works wherever possible are a great necessity for the State. Many points of routine nature as occurred to the Team during their visits were discussed with the local officers. The State authorities will, undoubtedly, give attention to the suggestions which emerge out of such mutual discussions. The Team's recommendations on matters of special significance as a result of the studies contained in the foregoing Chapters are summarised as below :—

1. For construction of earthen embankments the practice of building *Namuna's* (Profiles) ahead of work, should be followed to ensure good quality of work and proper alignment. (Para 2.5).
2. Some organisation, either State-managed or co-operative, should be devised to help the cultivators in levelling up their fields, contour bunding and anti-erosion measures wherever irrigation water is made available.
[Paras 2.8, 2.44(3), 6.7 & 6.8].
3. Outlet system on channels should be remodelled, wherever necessary, to enable maximum areas to be commanded through flow irrigation. (Para 2.10).
4. Lift irrigation should be allowed, wherever it involves light lifts. (Paras 2.11, 3.31 and 3.38).
5. Direct pumping from canals should be forbidden. Sumps for such pumping, if allowed, should be built outside the canal land. (Para 2.14).
6. *Khariif bandharas* do not seem to fulfil any irrigational requirement effectively. Their further construction should be discouraged. [Paras 2.16 & 2.44(1)].
7. In certain locations, where seepage losses from field channels are high owing to high permeability of soils, application of bentonite may help sealing the soils to some extent. Experiments thereabout may be tried. (Para 2.21).
8. Where series of *bandharas* exist on a river or a stream, they should be integrated into one compact system resulting in a more efficient distribution and economic utilisation of supplies available. (Paras 2.26 and 2.35).
9. Construction of various schemes should be taken up only after ascertaining adequate supply of water from established hydrological studies and not on 'ad hoc' basis. (Paras 2.29 & 2.30).
10. Land acquisition proceedings need to be expedited to enable channel construction to be done speedily.
[Paras 2.31 & 2.44(2)].

11. *Phad* system needs to be re-examined. It should be amended so as to enable more extensive use being made of the available supplies. (Para 2.33).
12. *Rabi bandharas* should be improved with regard to their supplies, through small storages being created in the upper reaches, wherever possible. [Para 2.44(5)].
13. To enable the estimates to be framed on a realistic basis, the yardstick of capital investment per acre should be revised as necessary, as effective capital-cost rates actually attained on a number of projects are much higher than project provided rates. (Paras 3.4 & 3.27).
14. State Government may take up experimental work on artificial rain-making in areas, where possibility of its success is indicated by meteorological conditions. (Para 3.8).
15. Closure of irrigation channels during night hours, which is a wasteful process, should be avoided. Irrigation at night should be encouraged. (Paras 3.12 & 3.46).
16. Proper gauges should be fixed at the head, tail and other control points of minor irrigation channels as is done on major canal systems. [Para 3.13(1)].
17. For economic use of water, existing practice of field to field irrigation, which proves wasteful, should be replaced by a properly aligned water courses on minor irrigation works also, as is the practice on major canals in the State. [Paras 3.20, 3.33(b) & 3.47]
18. An expeditious procedure may be evolved for action being taken in case of reservoirs (particularly those under Revenue Department) showing signs of leakage and needing engineering attention. (Paras 3.21 & 3.24).
19. Where irrigation is not progressing well, split-rate system of irrigation charges may be introduced. (Para 3.49).
20. To enable suitable legislative steps being taken to set matters right on ex-Malguzari tanks, the settlement operations in those areas may be expedited. (Para 4.7).
21. To check further deterioration in the condition of ex-Malguzari tanks resulting in a significant drop in their irrigational performance, a renovation programme should be taken up on an emergency basis. (Paras 4.8 & 4.9).
22. Recording of actual irrigation needs to be done on all State-managed works to enable their performance to be judged, irrespective of admissibility for levy of water rates on areas irrigated therefrom. (Para 4.12).
23. With irrigation water being available during winter months, steps should be taken to promote double cropping in Chanda and Bhandra districts. (Paras 4.13 & 6.9).

24. On suitable tanks, desilting-cum-reclamation plans should be evolved with the dual purpose of increasing capacity of the tanks and reclaiming the fore-shore areas.
(*Paras 4.23 & 4.24*).
25. Water pumped out from collieries and other types of mining operations, wherever found suitable for agricultural use, should be made use of on the neighbouring lands, if they are fit for cultivation.
(*Paras 4.25 & 4.28*).
26. The programme of sinking new wells and repairing old ones should be progressed vigorously side by side with soil conservation schemes, to improve irrigated agriculture in the State.
(*Paras 5.11 & 6.7*).
27. Siting of new wells should be done after thorough examination of the sub-soil water resources.
(*Para 5.12*).
28. Sanction of electric connections for pumping water from wells need to be accorded with due consideration to sub-soil supplies and not merely on the basis of availability of electricity.
(*Para 5.12*).
29. The system of irrigation through *mothe* needs to be improved. The practice of pulling up bullocks while retracing steps upslope to the well (as if in a reverse-gear) should be discouraged. Also, use of improved lifting appliances should be popularised.
(*Paras 5.13; 5.14 & 6.10*).
30. Siting of lift irrigation schemes should be done after investigations about the availability of water in the streams, keeping also in view any previous irrigational or riparian commitments.
(*Para 5.21*).
31. To have equitable distribution of water, roastering amongst the share-holders of lift irrigation societies be done and enforced through "*warabandi*" or "*Osrabandi*" system according to their irrigable areas in the command. This system could also be adopted on other irrigation works in the State wherever necessary.
(*Para 5.21*).
32. Maintenance of lifting equipment needs preferably to be entrusted to a competent agency instead of being done by individual co-operative societies with limited technical knowledge and resources.
(*Para 5.21*).
33. The State technical agencies may handle lift irrigation co-operative schemes for a couple of years before making them over to the co-operative societies.
(*Para 5.24*).
34. For coastal areas, where only one crop is taken in three years, a suitable crop pattern may be evolved to ensure a wholesome use of the land.
(*Para 6.2*).
35. Production of wheat needs to be stepped up by evolving high yielding, rust resisting, varieties as also oilseeds and cotton in irrigated areas.
(*Para 6.5*).

36. Sowing season of cotton in some areas like Nagpur Division could with advantage be advanced from June-July to April-May leading to greater production per acre. (Para 6.5).
37. (a) To restore fertility and counteract the depressing effect of *Jowar* on land, the existing main crop of the State, adequate manuring, fertilisation and inclusion of legumes and green manuring in the rotation seems necessary.
(b) Stress on green manuring requires to be given also, either before or after rice. (Para 6.9).
38. In irrigated areas, production of potato needs to be enhanced and also cultivation of sweet potato and tapioca introduced. (Para 6.10).
39. A concerted research programme to deal with all the problems of irrigated farming should be organised to evolve suitable methods of field water use. (Paras 6.10, 6.11 & 6.13).
40. Demonstration-cum-trial centres should be opened in increasing number, to ensure adoption of suitable crop patterns by the cultivators, wherever irrigation supplies are available. (Para 6.12).
41. A comprehensive survey of the potentialities of minor irrigation works, both State-owned and private, should be done on district or even block-wise basis. (Para 7.1).
42. In the wider interest of decentralisation, works in charge of Revenue Department, need to be gradually shifted to the charge of Village *Panchayats* or *Gram Samities*, who may be provided with necessary technical competence to look after them. (Para 7.6).
43. Early steps need be taken to evolve and enact a unified Canal Code for the State as a whole. (Para 7.7).
44. Study of ground-water-table behaviour may be conducted in areas where sub-soil water is exploited through mechanical pumping from wells and also in areas where new irrigation is introduced. (Para 7.8).
45. Some selected areas in the coastal strip may be taken for exploratory tubewell borings. (Para 7.9).
46. Pilot project may be started on terracing of selected areas in western slopes for the purpose of improving post-monsoon flow and enabling *rabi* cultivation to be done on emergent lands in upper contours. (Para 7.10).

Terms of Reference

(Minor Irrigation Team.)

The minor irrigation projects may be divided for study into two parts :—

- (a) Works already in existence.
 - (b) Works which are now being constructed.
2. Case studies should be made of a number of projects of each type under the above headings with a view to judging their efficiency having regard to the objectives with which such works were carried out.
3. The following points should be especially borne in mind :—

Existing Projects

- (i) The present state of repair and maintenance.
- (ii) The system of keeping works in proper maintenance with particular reference to the customary obligations of villagers for keeping such works in a sound condition from year to year, the team should also examine the extent to which these obligations are enforced, the reasons for the failure to do so and the steps that should be taken to carry out such obligations efficiently.
- (iii) Reasons, if any for non-utilisation of water by cultivators.
- (iv) Improvements necessary to make the projects more efficient either in the matter of better agricultural planning and practices or in respect of engineering works.
- (v) Cost of restoration if the project is in a state of disrepair and whether it has been included in the Plan.

New Projects

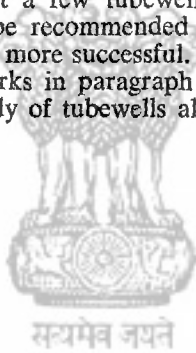
- (i) Method of selection—procedure and principles on which priorities are based.
- (ii) Flow Chart of the construction Project should be prepared to examine whether any avoidable delay has occurred in its completion.
- (iii) Whether fullest use is made of catchment capacity in preparing design.
- (iv) Economics of design.
- (v) State of agricultural planning with a view to optimum utilisation of benefits.
- (vi) Institutional arrangements provided for the proper maintenance of new works with special reference to the customary obligation of villagers in this regard.
- (vii) Cost of actual construction compared to estimated costs—the reasons for increase if any and the care with which the initial estimates were framed.

4. Any other matter which the Team considers necessary to report upon having a bearing on economy and efficiency of such projects.

5. The following information should be gathered by the Team for each State, taken as a whole in regard to existing minor irrigation works :—

- (i) The Total area irrigated from them according to Settlement registers.
- (ii) The area actually irrigated from year to year beginning from 1947.
- (iii) The reason for the reduction, if any, in the area irrigated.

6. In addition, the Team will carry out a study of the tubewell schemes of the Punjab and the U.P. with reference to the fact whether optimum use has been made of the facilities available by ensuring scientific crop planning and by improving agricultural practices. The study should be based on an examination of individual tubewells, which may be divided into most successful, successful and least successful varieties for the purpose of study. The Team should also select a few tubewells for which alternative crop planning and practices may be recommended that are being carried out at present in order to make them more successful. The consideration mentioned regarding minor irrigation works in paragraph 3 *mutatis mutandis* be taken into consideration for the study of tubewells also.





सत्यमेव जयते

Appendices

- I. Statement showing source-wise area irrigated in Maharashtra State during the year 1956-57. (1.10 & 5.11).
- II. Statement showing distributary-wise details of discharge, area under command and actual area irrigated during the years 1957-58, to 1960-61 on Urmodi Canal. (2.13).
- III. Copy of D.O. letter No. COPP/B/MIT/125 dated 24th Feb. 1961 from Shri Baleswhar Nath, Member, Minor Irrigation Team, addressed to Shri D. A. Gadkary, Chief Engineer, Irrigation, Sachivalaya, Bombay. (3.8).
- IV. Repairs to ex-Malguzari tanks in Bombay State—Payment of Grant-in-aid to the Co-operative Societies undertaking to carry out repairs. (4.5).
- V. Note on the design criteria for old tanks such as ex-Malguzari tanks in Vidarbha region in Maharashtra State. (4.9).
- VI. Copy of letter No. 3-1(1)/61-Agri dated the 10th February, 1961 from Shri B. P. Patel, Adviser, Programme Administration, Government of India, Planning Commission addressed to the Secretary (Planning) Maharashtra State. (4.27).
- VII. Copy of letter No. 3-2(7)/61-Agri dated the 21st October, 1961 from the Planning Commission, Government of India, New Delhi to the Development Commissioners/Planning Secretaries, all States. (7.3).
- VIII. Minutes of the meeting held at Sachivalaya, Bombay, on May 28, 1960.
- IX. Minutes of the meeting held at Sachivalaya, Bombay, on the 9th October, 1963.



सत्यमेव जयते

APPENDIX I
Statement Showing Source-wise Area Irrigated in Maharashtra State During the Year 1956-56
 (area in '00 acres)

District	Gross Area	Net Area Sown	Total area Irrigated	Per cent- tage Col. 3 to 4	Details of Area Irrigated										Other Sources	
					Govt. Canals		Private Canals		Wells		Tanks					
					Area	Per cent- tage	Area	Per cent- tage	Area	Per cent- tage	Area	Per cent- tage	Area	Per cent- tage	Area	Per cent- tage
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1 West Khandesh	39,798	17,319	763	4.40	310	40.63	24	3.14	426	55.23	3	0.40	—	—	—	—
2 Nasik	38,321	23,127	984	4.25	404	41.05	26	2.74	549	55.79	2	0.20	3	0.30	—	—
3 Thana	23,924	7,602	99	1.30	—	—	—	—	89	89.89	—	—	10	10.11	—	—
4 Greater Bombay	836	214	13	6.07	—	—	—	—	13	100.00	—	—	—	—	—	—
5 Kolaba	16,967	5,113	48	0.94	1	2.08	—	—	36	75.00	—	—	11	22.92	—	—
6 Ratangiri	31,662	8,562	319	3.73	6	1.90	121	37.90	129	40.44	14	4.40	49	15.36	—	—
7 Ahmednagar	42,049	31,052	2,773	8.93	1,005	36.24	43	1.55	723	62.14	2	0.07	17	0.85	—	—
8 Poona	38,452	24,595	2,016	8.19	984	48.80	50	2.48	906	44.94	59	2.93	12	0.74	—	—
9 North Satara	26,056	16,780	1,617	9.63	519	32.10	357	22.08	711	43.97	18	1.11	34	4.23	—	—
10 South Satara	21,287	15,814	804	5.08	25	3.12	17	2.11	728	90.54	13	1.75	426	57.42	—	—
11 Kohlapur	20,022	29,881	742	7.40	39	5.25	1	0.13	263	35.45	25	1.04	—	—	—	—
12 Sholapur	37,031	28,953	2,424	8.37	600	24.75	1	0.04	1,798	74.17	1	0.15	11	1.65	—	—
13 East Khandesh	28,763	19,859	667	3.36	50	7.50	—	—	920	100.00	—	—	—	—	—	—
14 Aurangabad	40,208	30,986	920	2.97	—	—	—	—	422	99.76	1	0.24	25	4.00	—	—
15 Parbhani	30,923	23,324	423	1.81	—	—	—	—	552	87.00	57	9.00	66	7.45	—	—
16 Bhur	27,599	19,486	634	3.26	—	—	—	—	778	87.85	6	0.70	16	1.85	—	—
17 Osmanabad	34,662	26,348	886	3.36	36	4.00	—	—	152	90.48	16	9.52	—	—	—	—
18 Nanded	29,759	19,682	168	1.85	—	—	—	—	165	98.22	2	1.19	1	0.59	—	—
19 Buldana	24,146	16,550	168	1.01	—	—	—	—	67	98.53	1	1.47	—	—	—	—
20 Akola	26,094	18,783	68	0.36	—	—	—	—	127	96.95	—	—	3	2.29	—	—
21 Amravati	30,138	16,577	131	0.79	1	0.76	—	—	51	94.45	—	—	1	1.85	—	—
22 Yeotmal	33,407	17,928	54	0.30	2	3.70	—	—	102	99.03	—	—	1	0.97	—	—
23 Wardha	15,537	9,843	103	1.05	—	—	—	—	313	52.69	144	24.24	38	6.40	—	—
24 Nagpur	24,430	12,965	594	4.58	99	16.67	—	—	27	1.28	1,672	79.09	57	2.69	—	—
25 Chanda	59,832	12,328	2,114	17.15	358	16.94	—	—	64	2.10	2,466	79.80	63	2.00	—	—
26 Bhandra	22,831	9,275	3,090	33.32	497	16.1	—	—	—	—	—	—	—	—	—	—
TOTAL	7,64,734	4,42,946	22,622	5.10	4,936	21.82	640	2.83	11,716	51.79	4,502	19.90	828	3.66		

Source: Hand Book of Basic Statistics of Maharashtra 1960.

APPENDIX II

Statement showing distributary-wise details of discharge, area under command and actual area irrigated during the years 1957-58, 1959-60 and 1960-61 on Urmodi Canal.

Distri- butary No.	Discharge of distri- butary head	Name of Village through which distributary passes	Irrigable area in acres Rice:Dry:Total	Area Irrigated during						Remarks
				1957-58		1958-59		1959-60		
				Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	
1	2	3	4	5	6	7	8	9		
1	0-16	Bharatgaon	3+ 7= 10	—	—	—	—	—	—	
2	0-12	Do.	2+ 6= 8	1-21	—	2-00	—	2-00	—	
3	0-07	Do.	2+ 2= 4	—	—	—	—	—	—	
4	0-34	Do.	7+ 13= 20	—	—	2-10	—	—	—	
5	0-10	Do.	2+ 4= 6	—	—	—	—	—	—	
6	0-07	Do.	2+ 2= 4	—	—	—	—	—	—	
7	0-07	Borgaon	2+ 2= 4	—	—	—	—	—	—	
8	0-42	Do.	8+ 18= 26	7-00	—	—	—	—	—	
9	0-165	Do.	3+ 7= 10	2-00	1-00	—	—	—	—	
10	0-265	Do.	5+ 11= 16	4-00	—	5-00	—	1-00	—	
11	1-38	Do.	29+ 53= 82	1-20	—	9-20	—	2-20	—	
12	0-85	Do.	18+ 30= 48	11-00	—	13-30	—	7-20	2-00	
13	0-155	Apsinghe	3+ 7= 10	—	—	—	—	—	—	
14	1-38	Do.	40+ 30= 70	3-20	2-20	15-00	—	0-20	7-20	
15	0-38	Do.	10+ 10= 20	—	—	—	—	—	—	
16	0-59	Do.	18+ 10= 28	8-10	—	10-00	—	1-00	4-20	
17	1-92	Do.	58+ 38= 96	15-10	—	29-20	—	2-20	13-00	
18	0-825	Maigaon	25+ 15= 40	21-00	—	10-00	—	—	—	
19	0-875	Do.	27+ 17= 44	11-00	—	10-20	—	—	7-00	
20	2-06	Do.	61+ 43= 104	35-20	4-20	62-00	—	2-00	5-00	
21	0-90	Do.	32+ 8= 40	—	—	—	—	27-00	7-00	
22	0-48	Do.	16+ 6= 22	15-20	—	12-20	—	6-20	2-00	

23	0.90	Do.	32+ 8=	40	10-20	—	—	6-00	—	4-20	2-00	—
24	3.71	Matyapur	127+ 43=	170	9-20	0-10	—	30-00	—	23-30	4-00	—
25	1.51	Do.	51+ 19=	70	3-20	—	—	6-00	—	8-30	2-00	—
26	0.10	Nisrale	4+ 0=	4	—	—	—	—	—	—	—	—
27	0.58	Do.	20+ 6=	26	—	—	—	—	—	—	—	—
28	0.30	Do.	10+ 4=	14	—	—	—	4-20	—	—	—	—
29	0.58	Do.	20+ 6=	26	—	—	—	5-20	—	—	—	—
30	0.59	Do.	20+ 6=	26	—	—	—	3-00	—	—	—	—
31	0.165	Do.	5+ 3=	8	—	—	—	4-00	—	—	0-20	—
32	1.92	Do.	66+ 22=	88	—	—	—	6-00	—	—	1-00	—
33	2.56	Do.	90+ 20=	110	—	—	—	40-00	—	13-30	4-00	—
34	4.38	Venegaon	150+ 50=	200	—	—	—	33-00	—	10-00	5-00	—
35	1.29	Do.	46+ 11=	57	—	—	—	18-00	—	—	3-00	—
36	24.52	Do.	799+ 363=	1162	—	—	—	162-00	5-30	75-00	51-20	—
37	11.26	Do.	420+ 61=	481	—	—	—	37-00	—	17-30	22-10	—
38	1.75	Nandgaon	58+ 24=	82	—	—	—	—	—	5-00	1-00	—
39	10.78	Do.	410+ 40=	450	—	—	—	—	8-00	11-20	29-00	—
40	0.90	Do.	32+ 8=	40	—	—	—	16-80	—	10-20	5-00	—
41	0.78	Do.	28+ 6=	34	—	—	—	—	—	4-00	—	—
42	4.89	Do.	188+ 15=	203	—	—	—	—	—	—	—	—
43	2.22	Do.	80+ 18=	98	—	—	—	—	—	—	—	—
					160-21	8-10	—	551-00	22-00	267-00	152-00	—

APPENDIX III

Copy of D.O. letter No. COPP/B/MIT/125 dated 24th Feb., '61 from Shri Baleshwar Nath, Member, Minor Irrigation Team, COPP., addressed to Shri D. A. Gadkary, Chief Engineer, Irrigation, Sachivalaya, Bombay.

You will recollect that during field study by the Minor Irrigation Team of Ahmednagar area, we discussed the question of some experimental trials on seeding of clouds for artificial rainfall in that area.

The subject of artificial rainfall is still very much in an experimental stage, and experiments conducted so far in the different parts of the world have not yet given results which may be treated as conclusive. As a member of the Rain and Cloud Physics Advisory Committee of the Scientific and Industrial Research Council, I tried to get the views of the Committee on the suitability of Ahmednagar area for carrying out cloud seeding experiments with a view to exploring possibilities of rain augmentation there. Though it is not possible to foresee the results of these experiments, it was felt on consideration generally of cloud and other meteorological features of the area, that Ahmednagar and neighbourhood should be a suitable venue for carrying out such trials. What the results will be, we do not know—they may in some cases be indeterminate or even negative. In fact, nothing can be predicted, because factors governing natural precipitation are too numerous. The experiments seek only stimulation of some natural processes, and have to follow, by and large, a pattern of hit or miss operations.

I am conveying this to you for the consideration of authorities at your end, so that Maharashtra Government may like to formulate a scheme for experimentation in Ahmednagar area.

The know-how of experimentation is available with the Rain and Cloud Physics Unit, National Physical Laboratory, New Delhi-12, who are themselves conducting experiments at three stations viz., Delhi, Agra and Jaipur.

Madras State are also carrying out such operations on the eastern slopes of Western Ghats for a couple of years and are establishing a new experimenting station at Trichnapalli.

In my opinion, it is worth-while trying these experiments. If they succeed, they may open up possibilities of increasing precipitation in these scarcity areas.

With kind regards, ———.

APPENDIX IV

Repairs to ex-Malguzari Tank in Bombay State—Payment of Grant-in-aid to the Cooperative Societies undertaking to carry out repairs.

GOVERNMENT OF BOMBAY
POLITICAL AND SERVICES DEPARTMENT

*Resolution no Irg-1459-S, Sachivalaya, Bombay 11th, December 1959,
Agrahayana, 20, 1881.*

Resolution : Consequent upon the abolition of Malguzari under the Madhya Pradesh Abolition of Proprietary Right Act, a large number of tanks in Vidarbha originally belonging to Malguzars vested in Government. These tanks, though, at present in a state of disrepair are capable of providing irrigation facilities for yielding increased food production in short time if maintained properly. Since Government has a heavy programme of major and minor irrigation works it was considered that for prompt repairs of these tanks they should be entrusted to the Village *Panchayat* or Cooperative Societies by giving them financial aid for the purpose.

Government has carefully considered these suggestions and is pleased to direct that :—

- (a) Grant-in-aid amounting to 50% of the cost of repairs should be given to the Cooperative Societies, *Gram Panchayat* or bodies of local beneficiaries willing to carry out repairs to these ex-Malguzari tanks subject to the condition that the overall cost of repairs per tank does not exceed Rs. 10,000.
- (b) The remaining 50% of the cost of repairs should be met by the Society, Village *Panchayat* or the body of local beneficiaries as the case may be by contribution in cash or by undertaking the work at below the normal rates.
- (c) The present position regarding Legal right both of Government and of the Irrigators under these tanks should remain '*status quo*'.
- (d) The expenditure on the scheme should be limited to the provision that may be made available annually within the overall Plan Provision.

2. The expenditure on this account should be met from the funds that may be placed at the disposal of the Collectors by the Agriculture and Forest Department on their demand, from within the Plan Provision.

By order and in the name of the Governor of Bombay.

APPENDIX V

Note on the Design criteria for old tanks such as ex-Malguzari tanks in Vidarbha Region in Maharashtra State.

(1) Previous History

Consequent upon abolition of proprietary rights in 1951, the *ex-Malguzari* tanks in Vidarbha region have been vested in the State Government. The number of such tanks is very large. These tanks have been constructed through different agencies in the last 100 years or more and are not, therefore, constructed to the design standard practised by the Irrigation Department of Maharashtra Government. While considering, therefore, the question of bringing these tanks to the standard of Government works, it was found that a very large amount of money would be required to do so, apart from the fact that such renovation will, therefore, take a considerable time. Moreover on such tanks, the beneficiaries have often the right of free irrigation and as such, even after heavy capital investments for renovation of these tanks, no additional revenue by way of irrigation water rates is likely to accrue. The design criteria of a sub-standard nature were, therefore, evolved. Details as regards the normal standards followed for new works and the sub-standards adopted for renovation of old tanks are given in the accompanying statement 'A'.

(2) Modifications made

The following modifications have been made in the design criteria :—

- (1) The free board has been reduced from 5' or 6' to 4'.
- (2) The top width of the bank has been prescribed as 6' against 10' for new construction works.
- (3) In case of new works 25 per cent encroachment on the free board provided has been allowed in case of the highest flood calculated as per Inglis formula. No allowance for flood absorption capacity is generally made. In case of *ex-Malguzari* tanks as the free board has already been considerably reduced, no encroachment on the free board or no allowance for flood absorption capacity has been allowed.
- (4) The highest flood discharge as per Inglis formula is calculated

$$Q_{\max} = \frac{7,000 A}{\sqrt{A+4}}$$

In case of the *ex-Malguzari* tanks, having a catchment of less than 20 sq. miles, the co-efficient is adopted as shown on the curve diagram enclosed.*

(3) Effect on the economy cost

With the changes in the free board and the top width of the bank, it was thought that considerable economy could be effected due to reduction in earth work, but in actual practice when the estimates for typical project

*Not reproduced.

were prepared, it was found that the cost of the waste weir formed a major portion of total cost of renovation. For effecting any appreciable economy in the cost of the project, it was considered necessary to effect economy on the cost of the waste weir, consistent with the safety of the work.

Different engineering authorities have been adopting different tables and formula to calculate the flood discharge. In *ex-Madhya Pradesh*, Garratt's tables based on Dicken's formula with co-efficient $C = 1,400$ and which take into account flood absorption capacity of the tank have been in vogue. Strange's curve is favoured by many authorities while some others preferred Ryve's Beale's or Ali Nawab Jang's curve. In the State of Maharashtra, the practice of adopting Inglis' formula have been recently in vogue. It was felt that for tanks having small catchment areas, this curve gives rather high figures of flood discharge. The accompanying blue print *shows the curve adopted in the State of Maharashtra for minor irrigation works having catchment areas up to 20 sq. miles.

Recent floods in Vidarbha region have again high lighted the desirability of adopting Inglis curve and has also raised doubts as to whether adoption of sub-standard design criteria in respect of free board, width of *bund etc.* is really desirable.

*Not reproduced.



APPENDIX V—(contd.)

Directorate of Minor Irrigation,
Maharashtra State, Poona-1.

Statement showing the normal standard followed for new works and the Sub-standard adopted for renovation of old tanks.

Item	Design standards for new works	Design standards for ex-Malguzari tanks	Remarks
(1)	(2)	(3)	(4)
1 Yield	To be worked out with Strange's coefficients.	No change.	
2 Percentage Dependability ..	Rainfall— Above 30" .. 75% 15" to 30" .. 60% below 15" .. 50%	No change.	
3 Designed flood Discharge $Q_{max} = \frac{7,000 A}{\sqrt{A+4}}$	1. Inglis formula where A is the area in square miles 2. 25% encroachment on free board may be allowed for rare floods. 3. Design flood should be judiciously fixed on the basis of local experience and formula modified by local factors.	As per the curve evolved. No encroachment on free board is to be allowed.	Not to be considered for the ex-Malguzari tanks.
4 Waste Weir	1. Flood absorption capacity may be left as a factor of safety where enough data is not available. 2. Where the empirical formula give a higher discharge than the one observed in actual practice, flood absorption capacity may be partially or fully taken into account.	No flood absorption is to be accounted for.	Not to be considered for the ex-Malguzari tanks.

5 (i) Dam Section

Height	Top width	Free board	Slope		Height	Top width	Free board	Slope	
			Up Stream	Down Stream				Up Stream	Down Stream
1. upto 30'	10'	5'-6'	2½ : 1 *(3 : 1)	2 : 1 *2½ : 1	0-10' 10'-30'	6' 6'	4' 4'	2 : 1 2½ : 1	2 : 1 2 : 1 6' 6'
2. 30'-40'	10'-12'	6'	2½ : 1 *(3 : 1)	6' cover *(10') cover	No change	No change			
3. 40'-60'	12'-16'	6'-8'	3 : 1	6' cover *(10') cover					

*Figures in bracket are for locations where the foundations are of inferior material. 6 feet cover is obtained by provision of berms of 10 feet width on the down stream side. Where the height of bund exceeds 50 feet, its stability has to be tested by slip circle method.

(ii) Hydraulic Gradient (Saturation Line).

4 : 1 in casing
2 : 1 in hearing
4 : 1 in old barks.

(iii) Cut off

.. .. Positive up to an impervious stratum in case of partial cut off study regarding providing an up-stream impervious blanket, the exit gradient and the amount of permissible leakage is essential.

No cut-off need now be provided as only raising of existing dams is proposed.

APPENDIX V—(concl'd.)

(1)	(2)	(3)	(4)
6 Silt pocket	 10% of the gross capacity. At the rate of 75 acre feet per 100 sq. miles catchment for 50-60 years.	No change.	
7 Evaporation losses	 As per P.W.D. Hand-book Ghat catchment 6.2' per year and 5' for fair weather. Deccan catchment— 8' per year 6' for fair weather.	6" on mean lake area as only paddy is the main crop.	

APPENDIX VI

Copy of letter No. 3-1(1)/61-Agri dated the 10th February, 1961 from Shri B. P. Patel, Adviser, Programme Administration, Government of India, Planning Commission addressed to the Secretary (Planning) Maharashtra State.

During one of the study tours of Maharashtra State the Minor Irrigation Team, Committee on Plan Projects of the Planning Commission, visited Chanda district in the State of Maharashtra. It was noticed at the site of Hindustan Collieries situated about a couple of miles from the town, that water to the extent of 30,000 gallons per hour was being pumped out which was not put to any use. It is also reported that an area of about 1,700 acres of virgin land which had been taken on lease from the State Government was available and could be developed for agricultural purposes. This would also have enabled the utilisation of the available water which at present remains unutilised. The Deputy Manager explaining the position stated that the lease was for underground exploitation of coal only and that over-surface agricultural development was not envisaged therein.

2. It is suggested that the State Government may consider the feasibility of utilising the water from collieries for agricultural production. They may also consider the terms of lease which may have to be suitably modified with a view to their utilisation for agricultural purposes. A pilot project may please be worked out for the Hindustan Collieries after testing the suitability of water for agricultural purposes. If the pilot project indicates the possibilities of success, the scheme may then be extended to other collieries.



APPENDIX VII

Copy of letter No. 3-2(7)/61-Agri dated the 21st October 1961 from the Planning Commission, Government of India, New Delhi, to the Development Commissioners/Planning Secretaries, All States.

Subject : MINOR IRRIGATION SURVEY AND COORDINATION OF MAJOR, MEDIUM AND MINOR IRRIGATION WORKS.

The major and medium irrigation works that are proposed to be taken up during the coming ten years are broadly known. The Central Water & Power Commission is preparing basin-wise reports on technological possibilities of irrigation projects showing the location of major projects, the irrigation potential of which is estimated at about 100 million acres. For minor irrigation, although the position in regard to the potentialities is not precisely known, a study on the subject of natural resources places the minor irrigation potential of the country at 75 million acres. A perspective view has, therefore, to be taken in regard to location of areas for major and minor irrigation schemes, and allocation of priorities as also funds for their execution by different agencies. District-wise information regarding the existing minor irrigation works is available in many of the States. However, there is distinct need for co-ordinating planning and investigation of future minor irrigation possibilities at the district level.

2. The need for undertaking systematic surveys was recognised by the Regional Minor Irrigation Conferences held in 1958, who had recommended setting up of properly staffed and equipped investigation units with definite jurisdictions, for this purpose. The Annual Conference of Community Development held in Srinagar in 1960, had recommended that at district and the State Level, Offices of the irrigation and Agriculture and Planning Departments should assess the irrigation requirements and possibilities in the Block and prepare Plan of works to be undertaken. The States may have already initiated action in implementation of these recommendations.

3. In compact areas where large number of minor irrigation works are in existence, care will have to be taken to see that they are not wasted on account of the execution of new major and medium irrigation projects. Similarly, in intensifying efforts for undertaking new minor irrigation works it should be seen that such works are not concentrated in areas where adequate perennial irrigation will be available before long through major and medium irrigation works. It would also be worthwhile to combine the system of flow irrigation and lift irrigation so as to maximise the use of stored water over a larger area and obviate the danger of water logging.

4. The minor irrigation works may include, among others, tanks, diversion channels, lift irrigation works and tube or percolation wells. The State Governments may indicate location only in respect of such works as are estimated to irrigate more than 100 acres. In regard to the rest, only the number and the estimated area to be irrigated under each category of works in a block or the district should be shown. The State Governments may also consider listing in a separate category works which cannot be justified strictly on grounds of financial returns but are recommended for execution as relief works as and when the need for them arises.

5. It is suggested that the State Governments may kindly prepare irrigation maps for the State as a whole indicating areas which will be served (1) by major and medium irrigation, (2) minor irrigation schemes with or without soil conservation schemes and (3) by soil conservation schemes. Such maps should be ready as soon as possible, preferably, in about a year's time so that a co-ordinated irrigation programme for the country as a whole can be drawn up for use of all agencies concerned with the subject.



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APPENDIX VIII

Meeting of the Minor Irrigation Team of the Committee on Plan Projects, with Maharashtra State Officers held at Sachivalaya, Bombay, on May 28, 1960.

The following were present :—

Maharashtra Government

1. Shri S. G. Barve, I.C.S., Secretary, Irrigation Deptt.
2. Shri G. V. Bedekar, I.C.S., Secretary, Agriculture & Forest Department.
3. Shri D. D. Sathe, Secretary, Co-operation & Rural Development Deptt.
4. Shri D. A. Gadkary, Director of Minor Irrigation, Poona.
5. Shri G. N. Godse, Joint Director of Agriculture, Poona.
6. Shri D. B. Anand, Chief Engineer (Irrigation) & Jt. Secretary to the Government, Irrigation Deptt.
7. Shri H. R. Patwardhan, Executive Engineer and P. A. to the Director of Minor Irrigation and Liaison Officer for Minor Irrigation Team.
8. Shri V. H. Kelkar, S. E., Nagpur Irrigation Circle.
9. Dr. M. B. Ghatge, Director of Agriculture, Poona-1.
10. Shri P. D. Kasbekar, Deputy Secretary, Finance Deptt. (Planning).
11. Shri D. G. Tungare, Under Secretary, Finance Department (Planning).

Minor Irrigation Team

1. S. Lal Singh.
2. Shri Baleshwar Nath.
3. Shri Mahavir Prasad.

S. Lal Singh, Member of the Minor Irrigation Team opened the discussion giving general outline of the objectives envisaged in the Terms of Reference of the Minor Irrigation Team, already forwarded to the State Governments by the Secretary, Committee on Plan Projects. He particularly drew attention to the importance of tanks in areas like those of Maharashtra and Gujarat States, where perennial supply of water was not there. On a query it was stated by Shri Anand, Chief Engineer, Irrigation, that tanks in Bombay State irrigated an area to the extent of about 4.2-lakhs acres, while the area occupied by the water spread of the tanks was of the order of one-sixth, to one-tenth of the area irrigated i.e., about 75,000 acres.

2. The Team was informed that maintenance of tanks was done in different parts of the State through different agencies and in different manners. While tanks irrigating areas above 250 acres were maintained by the Irrigation Department, others were in the charge of the Revenue

Administration. The *ex-Malguzari* tanks in the Vidarbha portion of the State, however, came under Bombay administration only in recent years. A policy regarding maintenance, extension of irrigation and realisation of irrigation charges from the beneficiaries in respect of these *ex-Malguzari* tanks was yet being formulated.

3. On the question of de-silting of tanks, it was pointed out by State engineers that the problem of silting up of tanks was not great in the State and the cost of de-silting the tanks was very high. It was, therefore, not adopted as a policy.

4. It was also stated by Shri Sathe that a large number of wells were used for irrigation purposes in the State. A development programme for well irrigation was also under way. Since the topography of Bombay State varied from region to region and the soil cover in various areas was poor, the use of wells was limited only to some parts of the State and could not be made universal. Experiments were, however, under way with regard to test yields of wells. It was stated that there are more than 9 lakh wells in the Bombay State serving almost 23-lakh acres of areas. For encouraging well irrigation an amount equal to the cost of construction of a new well or repairs to an old well subject to a maximum of Rs. 2,500 for new wells and Rs. 1,000 for repairs was given per well, out of which 25% or a maximum Rs. 500 were subsidy and the cost was recoverable in 10 yearly instalments along with interest charges at the rate of 4½%.

5. The Team Members wanted to know the policy of the Government with regard to the minor irrigation works that fell within the areas contemplated to be served by major irrigation schemes under construction. They were informed that minor irrigation works in such areas were undertaken only after ascertaining that they could not be served from the major schemes under execution.

6. Main crops sown in the State were *Jowar*, Wheat and gram in *rabi* season. In *khariif*, besides the rain-fed crops, cotton was also sown. Sowing of cotton is done in June, harvesting is done in December-January. On a suggestion that early cotton could be sown in some areas, it was accepted as a good policy, if water could be made available in April and May for sowing cotton crop.

7. With regard to utilisation of irrigation supplies on newly built schemes, it was stated that a sliding scale of water rates as given below was adopted in the State :—

					Food and fodder crop	Other crops
1st Year	..	..	..	..	No water rate	½ of normal rate.
2nd Year	..	..	..	..	1/3 rate	full of normal rate.
3rd Year	..	..	..	..	2/3 rate	—
4th Year	..	..	..	..	Full rate	—

8. On reference to Gujarat portion of the erstwhile Bombay State, Shri Gadkary informed us that in Gujarat Minor Irrigation was mainly from tubewells. He stated that there were 438 tubewells completed in First Five Year Plan, 270 in the Second Plan period and a plan provision of Rs. 75 lakhs was asked for in the Third Five Year Plan. These tubewells were

very slowly developing. They are provided with *pucca* lined channels up to a length such that the farthest point of a field is not more than $\frac{1}{2}$ mile from the extreme end of the lined channel. With regard to Saurashtra area, he said that E.T.O. has done test borings on 23 sites, but none of these had proved successful. Some more sites are proposed for trial by E.T.O. now.

9. With regard to case studies in the field, it was suggested that Team may visit representative areas, after the monsoon season, in the following regions :—

- (i) Bhandra and Chanda areas from Nagpur.
- (ii) Sholapur and Ahmednagar areas from Poona.
- (iii) Konkan Coastal area from Bombay.

With regard to Gujarat areas, it was suggested that case study could be fixed up in consultation with Gujarat Government authorities.

10. The Team was provided with a report of the Study Group on Irrigation and Power on the Third Five Year Plan of the Bombay State, as also a Report of the Study Group on Agricultural Production including development of Agricultural Co-operatives for the Third Five Year Plan. Besides, a copy of the Material for Examination by the Estimates Committee (1958), Vol. VI was also placed before the Team along with Handbook of Basic Statistics on Maharashtra State, 1960. It was stated that information with regard to Gujarat part of erstwhile Bombay State could be had from the State authorities of that State.

11. Further information required by the Team was noted by Shri H. R. Patwardhan, which was promised to be supplied to the Team in due course.

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APPENDIX IX

Committee on Plan Projects

(Irrigation Team)

Minutes of the meeting held at Sachivalaya, Bombay, on the 9th October, 1963.

Present

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| 1. Shri M. Thirumala Rao, M.P., Leader. Irrigation Team. | 1. Shri S. B. Chavan, Minister, Irrigation & Power. |
| 2. Shri Baleshwar Nath, Member, Irrigation Team. | 2. Shri Talyar Khan, Minister Civil Supplies. |
| 3. Dr. Arjan Singh, Member, Irrigation Team. | 3. Shri K. C. Nayar, Secretary, Irrigation & Power. |
| 4. Shri Mahavir Prasad, ex-officio Member, Irrigation Team. | 4. Shri R. C. Joshi, Secretary, F.A. & F.D. |
| | 5. Shri M. V. Dev, Secretary, C. & R.D.D. |
| | 6. Shri V. B. Manerikar, Chief Engineer M.I & P.H. |

In Attendance

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| (i) Shri J. R. Kumar, Research Officer, Irrigation Team. | (i) Shri V. H. Kelkar, S. E. (I) Deputy Secretary, (I & P). |
| | (ii) Shri P. G. Panze, Under Secretary, (I & P). |
| | (iii) Shri R. D. Gupte, Under Secretary, (I & P). |

Leader of the Team, Shri M. Thirumala Rao initiated the discussion on the points which emerged out of the comments sent by Maharashtra State Government on the draft report of the Team *vide* their letter No. MNS 1962/3758-M.I. (I) dated 22-8-1963, and Committee on Plan Projects D.O. No. COPP/B/MIT/63/2001, dated 30-9-1963.

1. *Question of allowing lift irrigation involving light manual lift from irrigation channels (paras 2.11, 3.31, 3.38).*

Commencing the discussion on the question of allowing lift irrigation from irrigation channels involving light manual lift, Shri Baleshwar Nath indicated the economy gained through such irrigation in the overall use of irrigation supplies, as also reduction in losses that otherwise occur if irrigation is given only to flow areas. He also quoted from para No. 3.4.17

of the Maharashtra State Irrigation Commission Report, (1962), which purported to say that area along canal or distributary, which is kept out of command should also be permitted to be irrigated if the prospective irrigators are willing to lift water at their own expense. He, however, did not think it equitable that rates for such lift irrigation should be the same as for flow irrigation because quantity of water actually used in lift irrigation is less than in flush irrigation, and that the irrigator has to undergo additional labour or expenditure in lifting water. In fact, he said, that in northern India, rate for such lift irrigation was only about half of what is assessed for flow irrigation. Shri Nayar, Secretary, Irrigation and Power Department felt that conditions in Maharashtra were different from those in northern India. He stated that minor irrigation works are seldom productive. Half water rate for lift irrigation would add to the burden on the State Exchequer. Besides levy of water rates is also based on many considerations. While, accepting the views of the Team in Principle, he said, the State authorities will like to deal with the question in an overall perspective of State's Financial policy.

2. *Question of integrating into one compact system a series of bandharas existing on one stream (para 2.26 and 2.35).*

The question of integrating into one compact system of a series of *bandharas* existing on any stream was next taken up. It was agreed that this was a desirable thing to do. The State Government would cause action to effect operational integration of such systems according to the sizes of different units *i.e.* if a large number of works fall within the categories maintained by the P.W.D., the entire system will be placed under the P.W.D., control, and if *vice-versa*, under the control of *Zila Parishads*.

3. *Question of expediting watercourses construction through amendment in regard to land acquisition procedure [para 2.31 and 2.44(2)].*

Regarding construction of watercourses and field channels, it was stated that the question of fixing responsibility on the beneficiaries is under consideration of State Government.

Shri Baleshwar Nath, however, pointed out that there was non-utilisation of irrigation supplies, particularly during cold weather on many minor and medium irrigation works in the State. He particularly quoted Asolamendha reservoir in Vidarbha region, where the water stored in the reservoir during cold season just evaporates away and is not utilised for irrigation purposes. Shri Nayar pointed out that there no tradition of winter cropping in that area. "*Bidi*" industry which is taken up by the local population on a cottage industry basis also inhibits any progress in that direction. He, stated that local usages and prejudices play an important part in the utilisation of water and quoted as examples Vidarbha area where *rabi* supplies are generally unutilised, while in Western Maharashtra and Marathwada areas *kharif* supplies are sometimes not utilised. Shri Baleshwar Nath suggested that some sort of incentive may be given to cultivators to utilise supplies available for irrigation in either season as their non-utilisation amounted to waste of a precious natural resource. Shri Chavan, Irrigation Minister, expressed concurrence to this suggestion and stated that the State Government would consider it.

4. *Question of extending the area of service wherever possible in respect of 'Phad' irrigation system (para 2.33).*

With regard to 'Phad' system of irrigation, Shri Baleshwar Nath contended that marginal areas which are sometimes denied the benefit of irrigation in spite of availability of supplies in the streams, may be given a chance of irrigation on at least second priority basis. After some discussion the Minister for Irrigation, Shri Chavan stated that the suggestion could be given effect to on a seasonal basis without in any way jeopardising the old established rights of the beneficiaries of the system. The suggestion was thus accepted, inasmuch as it aimed at fuller utilisation of the supplies when the overflow from different weirs eventually proved to be surplus to the requirements of 'Phad' areas.

5. *Question of augmenting supplies on rabi bandharas [para 2.44(5)].*

The question of augmenting supplies on *rabi bandharas* was accepted by the State authorities.

6. *The problem of encouraging irrigation being done at night (para 3.12 and 3.46).*

Shri Baleshwar Nath referred to the issue of night irrigation. He said that this problem is faced not only in Maharashtra but also in those parts of Gujarat and Saurashtra, where rainfall is very low. The Minister for Irrigation and Power Shri Chavan stated that the real problem is to change from dry to wet farming and night irrigation will automatically take place as demand for water develops. This unfortunately takes time. As it is, all projects are conceived on the basis of day and night irrigation. Dr. Arjan Singh remarked that opening of channels in the morning and closing them at night seem to resemble the concept of office working. This he said was not conducive to efficiency in field operations like irrigation and involved considerable wastage of water. Shri Baleshwar Nath intervened saying if the demand was not such as to require the channel-running day and night, it would be more economical and operationally more wholesome if channels are run say for 3 days at a stretch in a week.

7. *Question of imposing 'split-rate' system of irrigation or say introduction of 'two part tariff' (para 3.49).*

Regarding levy of water rates on 'two-part tariff' basis, the Secretary, Irrigation & Power Department said that the need of compulsory cess seems indisputable. Maharashtra State Irrigation Commission in para 3.8 of its report recommended abolition of this kind of cess leviable under section 56C to 56F of the Bombay Irrigation Act. Views of the Irrigation Department and those of Irrigation Commission are under consideration of the State Government.

8. *Desilting-cum-reclamation of silted tanks; its overall economic aspect to be considered (para 4.23 and 4.24).*

The Leader, Shri M. Thirumala Rao enquired as to how many tanks in Maharashtra State require desilting and reclamation, to which the

Minister, Shri Chavan replied that technical advice in their State does not favour desilting-cum-reclamation and instead it preferred construction of new tanks. Dr. Arjan Singh indicated that desilting-cum-reclamation not only helps conserving supplies of water but it also leads to reclamation of land, which is equally precious. The State authorities, however, contended that in the special topographical conditions of Maharashtra State, the ratio of land submerged in tank to the area irrigated therefrom, was not so high as to warrant costly operation of desilting-cum-reclamation. They said that conditions in Maharashtra were different than those in the southern parts of Indian peninsula, where water spread of tanks was comparatively extensive. The Team, however, felt that a long range view should be taken of the problem. The policy of desilting of tanks along with that of reclamation of land needs to be adopted wherever economically and practically feasible.

9. *Question of progressing repair programme of old wells (para 5.11 and 6.7).*

The Leader, Shri M. Thirumala Rao enquired as to how much money was being spent by the State on repairs and renovation of derelict wells, and if Government of Maharashtra was giving any subsidy for such works. The State authorities indicated that State Government gave subsidies to the extent of Rs. 500 for each new well and that a programme for repairs of old wells is already under way. The State Minister for Civil Supplies, Shri Talyar Khan raised the point regarding shortage of cement and corrugated iron sheets and stated that this was holding up the progress of the programme of wells construction and repairs.

10. *The problem of enforcement of Warabandi and Osrabandi systems accepted in principle by the State (para 5.21).*

With regard to enforcement of warabandi and osrabandi with particular reference to lift irrigation societies, the State authorities accepted the recommendation in principle. With regard to actual implementation of the recommendation, it was stated, that this was a matter of details and will be looked into by the concerned authorities in due course.

11. *Problem of maintenance of lift equipment on lift irrigation scheme (para 5.21).*

With regard to maintenance of lift equipments, the Minister of Irrigation and Power stated that Government does not come into the picture and some of the lift irrigation societies like those at Kohlapur have got their miniature workshop to attend to their repairs. Other irrigation societies go to the open market for getting repairs done to their equipments, whenever necessary.

Shri Baleshwar Nath further raised a point regarding survey and assessment of underground resources of water preferably in collaboration with Geological Survey of India so that there is no over-drawal of supplies from sub-soil reserves. The State authorities concurred with the view and stated that a Master Plan in this connection is being worked out by the State.

The Leader of the Team Shri M. Thirumala Rao thanked the State authorities for arranging the discussion and helping the Team to finalise the draft report on the study of minor irrigation works in Maharashtra State.





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